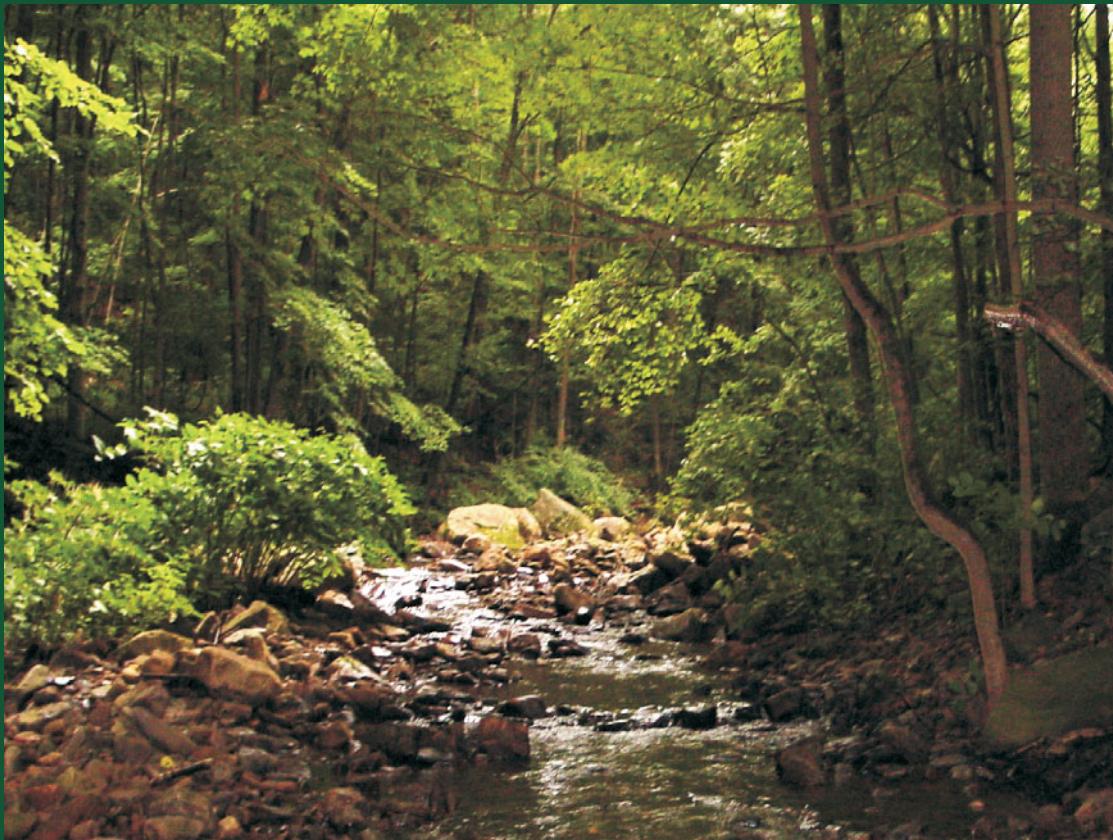


MARYLAND BIOLOGICAL STREAM SURVEY

2000-2004

Volume XI



Sentinel Site Network



CHESAPEAKE BAY AND
WATERSHED PROGRAMS
MONITORING AND
NON-TIDAL ASSESSMENT
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**Maryland Biological Stream Survey
2000-2004**

Volume 11: Sentinel Site Network

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22 July 2005

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Resource Assessment Service
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FOREWORD

This report, *Maryland Biological Stream Survey 2000-2004 Volume 11: Sentinel Site Network*, was prepared by staff from the Maryland Department of Natural Resources' Monitoring and Non-Tidal Assessment Division. It was supported by Maryland's Power Plant Research Program (PPRP Contract No. K00B0200109 to Versar, Inc.).

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ABSTRACT

Assessing natural year-to-year variability in stream conditions requires high quality streams with minimal anthropogenic influences. Although there are no longer any pristine streams in Maryland, the Maryland Biological Stream Survey (MBSS) has identified and monitored minimally impacted streams that represent all regions (i.e., Coastal Plain – eastern shore, Coastal Plain – western shore, Eastern Piedmont, and Highlands) and stream orders (1st through 3rd) in Maryland from 2000-2004. In natural streams, annual and seasonal variations in precipitation are important factors affecting water quality and the quantity and quality of physical habitat available to aquatic organisms. Stress caused by these changes can have drastic effects on both fish and benthic macroinvertebrate communities. Based on precipitation data collected and compiled by NOAA (1999-2003), annual precipitation totals, and subsequently the departures from normal, were all below normal for all regions of Maryland in 2001. In 2002, drought conditions continued to worsen from January through the late summer. During the latter part of 2002 (October – December), conditions improved significantly as wetter than normal conditions were observed, ending the drought emergency in Maryland. Overall, the drought of 2001 and 2002 is one of the worst on record. Fish and benthic macroinvertebrate indices of biotic integrity (FIBI and BIBI, respectively), as well as the Combined Biotic Index (CBI) (average of FIBI and BIBI) were used to document temporal trends that result from natural variation from 2000 to 2004. Index of biotic integrity (IBI) scores range from 1 (worst) to 5 (best). Variability in the mean annual FIBI, BIBI, and CBI scores (calculated as highest mean IBI minus the lowest mean IBI) was negligible for the Coastal Plain – eastern shore, Eastern Piedmont, and Highlands regions (variability from 2000 to 2004 in these regions was less than 0.75). These results suggest that stream conditions in these regions remained relatively stable from 2000 to 2004 despite the drought (2001 to 2002). However, the drought had significant impacts on the fish and benthic macroinvertebrate communities in the Coastal Plain – western shore region. The mean annual FIBI, BIBI, and CBI scores were the lowest in 2003 (the year immediately following the drought). Variability was 1.44 for the FIBI, 1.10 for the BIBI, and 1.27 for the CBI. If data collected in 2003 were excluded from the analysis, variability would be 0.17 for the FIBI, 0.48 for the BIBI, and 0.22 for the CBI. Overall, five of the six sentinel sites in this region received their lowest CBI scores in 2003 since monitoring at these sites was initiated. Despite the fact that the drought of 2001 and 2002 impacted all four regions of Maryland, streams in the Coastal Plain – western shore region responded significantly, often becoming standing pools with many dewatered areas. Overall, five of the six sites sampled in this region in 2002 were reduced to standing pools. During this time, fish and benthic macroinvertebrate communities were experiencing important changes in water quality (e.g., reduced dissolved oxygen concentrations) and the quantity and quality of the physical habitat available. Stress caused by these changes reduced abundances and altered community composition, reducing IBI scores the following year (2003). This study illustrates that, although a severe drought can be widespread, the response of streams, and subsequently their biota, is different regionally.

TABLE OF CONTENTS

FOREWORD	11-iii
ACKNOWLEDGEMENTS.....	11-iv
ABSTRACT	11-v
11.1 INTRODUCTION.....	11-1
11.2 SENTINEL SITE SELECTION	11-2
11.3 SENTINEL SITE NETWORK	11-3
11.3.1 2004 Sentinel Site Results.....	11-3
11.4 GENERAL DESCRIPTIONS OF SENTINEL SITES BY GEOGRAPHIC REGION	11-3
11.4.1 Coastal Plain – eastern shore region	11-3
11.4.2 Coastal Plain – western shore region.	11-4
11.4.3 Eastern Piedmont region.	11-4
11.4.4 Highlands region	11-5
11.5 CLIMATIC CONDITIONS	11-5
11.6 INTERANNUAL VARIABILITY AT SENTINEL SITES.....	11-6
11.7 DISCUSSION	11-8
11.8 REFERENCES	11-10

APPENDICES

A. Sentinel Sites in the Coastal Plain – Eastern Shore Region	A-1
B. Sentinel Sites in the Coastal Plain – Western Shore Region	B-1
C. Sentinel Sites in the Eastern Piedmont Region.....	C-1
D. Sentinel Sites in the Highlands Region.....	D-1

LIST OF TABLES

Table No.		Page
11-1	Years in which sentinel sites have been sampled in each geographic region	11-12
11-2	Sites sampled in 2004 that met sentinel site screening criteria, MBSS 2004 data are shown	11-13
11-3	Comparisons of MBSS Round 1 and Round 2 results for selected parameters at sentinel sites.....	11-16
11-4	Maximum differences for sentinel sites by region for Round 2 of the MBSS.....	11-21

LIST OF FIGURES

Figure No.		Page
11-1	Locations of sentinel sites in the Coastal Plain – eastern shore region of Maryland	11-22
11-2	Average land use categories for sentinel sites by region	11-23
11-3	Locations of sentinel sites in the Coastal Plain – western shore region of Maryland	11-24
11-4	Locations of sentinel sites in the Eastern Piedmont region of Maryland.....	11-25
11-5	Locations of sentinel sites in the Highlands region of Maryland.....	11-26
11-6	Annual precipitation summaries for the Coastal Plain – eastern shore region of Maryland.	11-27
11-7	Annual precipitation summaries for the Coastal Plain – western shore region of Maryland	11-28
11-8	Annual precipitation summaries for the Eastern Piedmont region of Maryland	11-29
11-9	Annual precipitation summaries for the Highlands region of Maryland	11-30
11-10	Mean annual FIBI, BIBI, and CBI for sentinel sites by region.....	11-31

11.1 INTRODUCTION

The Maryland Biological Stream Survey (MBSS) provides an opportunity to examine trends in stream conditions over time. These trends are affected by natural variations and/or anthropogenic influences. Each year, the MBSS monitors a network of high quality reference sites, known as sentinel sites, to aid in assessing natural year-to-year variability in stream conditions.

In natural streams, trends in ecological condition across years should be attributable primarily to variations in precipitation (causing droughts or floods) and temperature regimes, as well as biotic interactions among native species. Therefore, annual monitoring information from minimally disturbed sites in locations not likely to experience future anthropogenic disturbance (i.e., sentinel sites) offers the best means of interpreting the degree to which changes in biological indicator scores result from natural variability.

Although there are no longer any pristine streams in Maryland, monitoring a set of the best remaining streams offers a reasonable alternative for evaluating natural variability. During 2000, the MBSS established the Sentinel Site Network. The Network consisted of some of the best remaining streams in Maryland based on physical, chemical, and biological data collected by the MBSS from 1995-1997 (Round One). These streams represented all regions and stream orders (1st through 3rd), and were located in catchments that would not likely experience increases in anthropogenic disturbances. In 2001-2004, the MBSS continued annual sampling at a set of sentinel sites. This volume describes the methods used to select these sites and presents the sampling results from Round One and Round Two (2000-2004) of the MBSS. This volume also reports on changes in stream conditions that resulted from natural variability during Round Two (period during which annual sampling at all sentinel sites occurred).

11.2 SENTINEL SITE SELECTION

To ensure that sites with minimal anthropogenic impacts were selected as long-term sentinel sites, a three-tiered framework of land use, water quality, and biological community criteria was established and applied to all sites sampled by the MBSS from 1995 to 1997. The following Tier 1 criteria were used to identify candidate sentinel sites:

- no evidence of acid mine drainage (AMD) in the site catchment;
- sulfate < 50 mg/l;
- pH > 6.0 or dissolved organic carbon (DOC) > 8.0 mg/l (i.e., pH could be < 6 if the stream is a naturally acidic blackwater stream);
- nitrate nitrogen < 4.0 mg/l;
- percent forested land use > 50% of catchment area; and
- Combined Biotic Index (CBI, calculated as the mean of the fish and benthic macroinvertebrate indices of biotic integrity, FIBI and BIBI, respectively) > 3.0, or blackwater stream.

In addition, streams not previously sampled quantitatively by the MBSS, but likely to meet the above criteria, were included in the initial pool of candidate sentinel sites.

Candidate sentinel sites were grouped according to stream order (1st through 3rd) and geographic region (Coastal Plain – eastern shore, Coastal Plain – western shore, Eastern Piedmont, or Highlands) to facilitate representation of small, medium, and large streams throughout Maryland. Criteria were also applied to ensure that the candidate sites were likely to remain minimally disturbed for the foreseeable future. The Tier 2 list of provisional sites was compiled using the following criteria:

- minimum of five sites in each geographic region;
- minimum of five sites in each stream order;
- a large amount of the catchment located within protected lands (e.g., The Nature Conservancy Preserves, state forests, etc.); and
- sampling site itself located on public land.

Therefore, the provisional Sentinel Site Network consisted of six or seven sites in each of the four geographic regions that appeared to have the least human disturbance and the least likelihood of changing in the future from human-related activities in their catchments. To compile the final Tier 3 selected sentinel sites, DNR biologists reviewed information from external sources and conducted site visits when needed to confirm land use or other watershed conditions.

11.3 SENTINEL SITE NETWORK

Prior to the 2000 MBSS sampling season, 27 sites were selected for the Sentinel Site Network using the three-tiered process based on the land use, water quality, and biological community criteria described above. These sites were either selected from sites sampled during Round One (1995-1997) of the MBSS, or from streams with existing ecological and land use information warranting their inclusion. Roth et al. (2005) provide information on the 2000 Sentinel Site Network and documents how the Sentinel Site Network changed from 2000-2003. As needed, sentinel sites were replaced to ensure that adequate numbers of minimally disturbed sites were available in each geographic region. The final Sentinel Site Network consisted of 26 sites, all of which have been consistently sampled since 2002 (Table 11-1).

11.3.1 2004 Sentinel Site Results

This section summarizes the results from information collected by the MBSS in 2004 (Roth et al. (2005) presents the results from 2000-2003). Of the 290 sites sampled by the MBSS in 2004 (including the 26 sentinel sites), 83 met initial sentinel site screening criteria (Table 11-2). Of the 26 sentinel sites, 24 continued to meet the sentinel site criteria. Leonard Pond Run (WIRH-220-S) did not meet the criteria because the nitrate-nitrogen concentration exceeded 4.0 mg/l (4.33 mg/l). This site violated the nitrate-nitrogen threshold in 2002, but was never removed from the Sentinel Site Network because it represents the only second order stream in the Coastal Plain – eastern shore region that met other criteria for inclusion in the Network. The unnamed tributary to Dipping Pond Run (JONE-109-S) did not meet the sentinel site criteria because the Combined Biotic Index did not exceed 3.0. The unnamed tributary to Dipping Pond Run is a headwater stream of Jones Falls and is classified as a coldwater system because the maximum daily mean water temperature is less than 22°C and dissolved oxygen levels exceed 5.0 mg/l (Appendix A). Brook trout, Maryland's only native trout species, was found in this stream along with introduced brown trout. This site will remain in the Sentinel Site Network due to the paucity of streams in the Eastern Piedmont that meet sentinel site criteria.

11.4 GENERAL DESCRIPTIONS OF SENTINEL SITES BY GEOGRAPHIC REGION

11.4.1 Coastal Plain – Eastern Shore Region

The Coastal Plain – eastern shore region is the portion of Maryland east of Chesapeake Bay that extends from the fall line south and east. Figure 11-1 illustrates the locations of sentinel sites and protected lands in this region. Although the goal of the Sentinel Site Network was to identify streams where a large amount of the watershed was located within protected lands, this was difficult in the Coastal Plain – eastern shore region. Only three of the six streams (Millville Creek – NASS-108-S; Nassawango Creek – NASS-302-S; and Swan Creek – LOCR-102-S) have significant amounts of protected lands within their watersheds. Based on data from Vogelmann et al. (2001), average land use for all sentinel site catchments

in this region is 72.8% forested, 22.1% agricultural, and 1.3% urban (Figure 11-2). The sentinel sites in the Coastal Plain – eastern shore region are located on blackwater streams or streams that have characteristics similar to this aquatic habitat type. Blackwater streams are characterized by low acidity, generally with pH levels less than 6 (or ANC values less than 200 ueq/l), and dissolved organic carbon greater than 8 mg/l (Roth et al. 1998). Substrate consists primarily of silt, sand, and organic matter, with minor and isolated amounts of small gravel. Because of the lack of larger, more stable substrate, instream woody debris and submerged aquatic vegetation are important in defining hydrologic features and providing cover for aquatic biota. Appendix A provides biological (fish, benthic macroinvertebrate, and herpetofauna), water chemistry, and physical habitat data for all sentinel sites in the Coastal Plain – eastern shore region for each year they were sampled. In addition, Table 11-3 allows direct comparisons of annual results for only the parameters used for sentinel site selection.

11.4.2 Coastal Plain – Western Shore Region

The Coastal Plain – western shore region is the portion of Maryland west of Chesapeake Bay that extends north and west to the fall line. Figure 11-3 illustrates the locations of sentinel sites and protected lands in this region. Only one of the six streams (Mattawoman Creek – MATT-033-S) has significant amounts of protected lands within its watershed. Based on data from Vogelmann et al. (2001), average land use for all the sentinel site catchments in this region is 78.7% forested, 16.7% agricultural, and 3.8% urban (Figure 11-2). Sentinel sites in the Coastal Plain – western shore region are low gradient (<1.5%) and found at elevations of less than 50 feet above sea level. Silt, sand, gravel, and small cobble are the dominant substrates. Because these streams lack stable substrates such as bedrock and boulders, wood and submerged aquatic vegetation are important channel features. Submerged logs and tree roots slow the flow of nutrients and sediment, provide cover for fishes and stream insects, and control stream bank erosion. Appendix B provides biological (fish, benthic macroinvertebrate, and herpetofauna), water chemistry, and physical habitat data for all sentinel sites in the Coastal Plain – western shore region for each year they were sampled. In addition, Table 11-3 allows direct comparisons of annual results for only the parameters used for sentinel site selection.

11.4.3 Eastern Piedmont Region

The Eastern Piedmont region of Maryland has the Catoctin Mountains in Frederick County as its western boundary and the fall line as its eastern boundary. Figure 11-4 illustrates the locations of sentinel sites and identifies the protected lands in this region. Only one of the six streams (Baisman Run – LOCH-120-S) has significant amounts of protected lands within its watershed. Based on data from Vogelmann et al. (2001), average land use for all the sentinel site catchments in this region is 70.7% forested, 26.8% agricultural, and 0.9% urban (Figure 11-2). Sentinel sites in the Eastern Piedmont region are located on low to moderate gradient (1-3%) streams with predominately gravel-cobble substrates. Streamside trees and logs play an important role in shaping the stream channel and banks, creating pools and slow-water areas beneficial to many aquatic species. Logs and leaf litter are also a primary source of organic matter forming the base of the food web in these streams. Appendix C provides

biological (fish, benthic macroinvertebrate, and herpetofauna), water chemistry, and physical habitat data for all sentinel sites in the Eastern Piedmont region for each year they were sampled. In addition, Table 11-3 allows direct comparisons of MBSS Round 1 and Round 2 results for only the parameters used for sentinel site selection.

11.4.4 Highlands Region

The Highlands region of Maryland includes the Appalachian Plateau, Valley and Ridge, Blue Ridge, and the western part of the Piedmont physiographic province. Figure 11-5 illustrates the locations of sentinel sites and identifies the protected lands in this region. All sentinel sites in the Highlands region have a significant amount of protected lands within their watersheds. Based on data from Vogelmann et al. (2001), average land use for all the sentinel site catchments in this region is 89.1% forested, 8.9% agricultural, and 0.9% urban (Figure 11-2). Six (Bear Creek – YOUG-432-S; Buzzard Branch – UMON-119-S; Crabtree Creek – SAVA-204-S; Double Lick Run – SAVA-276-S; Mill Run – PRLN-626-S; and Savage River – SAVA-225-S) of the eight streams in the Highlands region are classified as coldwater streams. These streams have a maximum daily mean water temperature less than 22°C and dissolved oxygen levels that exceed 5.0 mg/l (Appendix D). In addition, various trout species including brook trout, rainbow trout, and brown trout can be present. Sentinel sites in the Highlands region are on high gradient streams with primarily gravel, cobble, and boulder substrates. Because many of these streams fall within the rain shadow of the Appalachian Mountains, they receive the lowest annual rainfall amounts in the state. Consequently, stream flow in the summer is often markedly reduced. Streamside trees and logs play an important role in shaping Highlands stream channels and banks, creating pools and slow water areas beneficial to aquatic species. Logs and leaf litter are also a primary source of organic matter forming the base of the food web in these streams. Appendix D provides biological (fish, benthic macroinvertebrate, and herpetofauna), water chemistry, and physical habitat data for all sentinel sites in the Highlands region for each year they were sampled. In addition, Table 11-3 allows direct comparisons of annual results for only the parameters used for sentinel site selection.

11.5 CLIMATIC CONDITIONS

Annual and seasonal variations in precipitation are important factors affecting water quality and the amount and quality of physical habitat available to aquatic organisms in lotic environments. Figures 11-6 to 11-9 illustrate the monthly deviations from normal precipitation (normal defined as the mean computed over at least three consecutive 10-year periods) from 1999 to 2003 (NOAA 1999; NOAA 2000; NOAA 2001; NOAA 2002; NOAA 2003) for each geographic region (i.e., Coastal Plain – eastern shore, Coastal Plain – western shore, Eastern Piedmont, and Highlands). The numbers presented on each chart represent the average deviation from normal precipitation monthly and for the year.

The total precipitation for 1999 and 2000 was normal to above normal for the Coastal Plain – western shore, Coastal plain – eastern shore, and the Eastern Piedmont regions. However, the Highlands region had deficits for both years (5.78 inches for 1999 and 3.09 inches for

2000 – likely the result of the rain shadow caused by the Appalachian Mountains). In 2001, January through July had precipitation totals that were normal to slightly below normal for all geographic regions. However, beginning in August of 2001, precipitation totals began to fall short of normal amounts. In fact, the annual precipitation totals were all below normal for all regions in 2001. Departures from normal ranged from 3.93 inches in the Coastal Plain – eastern shore region, to 8.53 inches in the Eastern Piedmont. In 2002, drought conditions continued to worsen from January through late summer. Extremely dry conditions existed for the entire state, leading Governor Parris N. Glendening to declare a drought emergency. Restrictions on water consumption were mandated throughout the state. By August of 2002, the driest September to mid-August period in Baltimore was recorded since 1871 (Walston 2002). During the severe drought that spanned 2001 and most of 2002, many streams across the state had extremely low flows, with some becoming standing pools or completely dewatered. During the latter part of 2002 (October – December), conditions improved significantly as wetter than normal conditions were observed, ending the drought emergency in Maryland. Figures 11-6 – 11-9 illustrate that 2003 was a very wet year. The annual precipitation totals were all well above normal for all regions. Departures from normal ranged from 9.17 inches for the Highlands, to 22.25 inches for the Eastern Piedmont.

11.6 INTERANNUAL VARIABILITY AT SENTINEL SITES

Assessing natural year-to-year variability in stream conditions requires high quality streams that lack anthropogenic influences. Although there are no longer any pristine streams in Maryland, the MBSS has identified and monitored minimally impacted streams that represent all regions and stream orders (1st through 3rd) in Maryland. Based on land use information, the majority of watersheds upstream of sentinel sites are dominated by forest, with very little agricultural and/or urban influences (Figure 11-2).

Natural variability in lotic environments is primarily caused by annual and seasonal variations in precipitation and corresponding flows that result in fluctuations in the physical characteristics of stream ecosystems (Grossman et al. 1990). Water quality (e.g., pH, dissolved oxygen) can vary greatly between floods and drought events. Additionally, stream channel morphology, substrate composition, and habitat availability can change in response to fluctuating flows. The abundance and composition of stream fish and invertebrate communities respond to these changes (McElravy et al. 1989, Boulton et al. 1992, Poff and Allan 1995).

Fish and benthic macroinvertebrate indices of biotic integrity (FIBI and BIBI, respectively) are stream assessment tools used to evaluate the biological integrity or ecological quality of a stream based on the characteristics of fish and macroinvertebrate assemblages (Roth et al. 2003). FIBIs and BIBIs, as well as the Combined Biotic Index (CBI) were used to document temporal trends from 2000 to 2004 that result from natural variations. Fish and benthic macroinvertebrate (IBIs) for the State of Maryland were originally developed for use during the first round of MBSS (1995 to 1997) (Roth et al. 2000, Stribling et al. 1998), and were revised at the conclusion of Round 2 in 2004 (Southerland et al. 2005). The revised IBIs for

Round 1 and Round 2 are reported in this volume. Index of biotic integrity (IBI) scores range from 1 (worst) to 5 (best).

Figure 11-10 illustrates the mean annual FIBI, BIBI, and CBI scores for sentinel sites by region (2000-2004). Variability in these indices was negligible for the Highlands, Eastern Piedmont, and Coastal Plain – eastern shore regions (Table 11-4). These analyses suggest that, overall; stream conditions in these regions remained relatively stable from 2000 to 2004 despite the drought (2001 and 2002) and extremely wet conditions in 2003. However, the drought had significant impacts on the fish and benthic macroinvertebrate communities in the Coastal Plain – western shore region. The mean annual FIBI, BIBI, and CBI scores were the lowest in 2003 (the year immediately following the drought). Variability (calculated as highest mean IBI minus the lowest mean IBI) was 1.44 for the FIBI, 1.10 for the BIBI, and 1.27 for the CBI (Table 11-4). If the data collected in 2003 were excluded from the analysis, variability would be 0.17 for the FIBI, 0.48 for the BIBI, and 0.22 for the CBI. Overall, five of the six sentinel sites in this region received their lowest CBI scores in 2003 since monitoring at these sites was initiated.

Despite the fact that 2002 was a very dry year, sentinel site FIBI, BIBI, and CBI scores were not consistently low due to the drought and low flow conditions in 2002 (Table 11-3). The real impact of the drought was much more obvious in 2003, based on the FIBI, BIBI, and CBI results. Appendix C illustrates how stream flows in 2002 at the sentinel sites in the Coastal Plain – western shore region were impacted by the drought. Overall, five of the six sites sampled during the summer period were reduced to standing pools. During this time, the fish and benthic macroinvertebrate communities were experiencing drastic changes in water quality and the amount of physical habitat available. As a result, the abundance and compositions of these communities changed, resulting in reduced IBI scores the following year (2003). Overall, both BIBI and FIBI scores were consistently low in the Coastal Plain – western shore region during 2003, thus documenting temporal trends that result from natural variability. Results from 2003 also suggest that the fish community may have been impacted more by the drought than the benthic macroinvertebrate community (based on index scores). Potential explanations for this observation include differences in sampling period (benthic macroinvertebrates were sampled in the spring, while fish were sampled in the summer) and/or the fact that benthic macroinvertebrates can use the hyporheic zone for refugia during a drought and can recolonize an area readily through drift or flight across the landscape. Results from 2004 (Table 11-4) indicate that both the BIBI and FIBI scores rebounded in the Coastal Plain – western shore region and were consistent with results from years prior to the drought.

Although the drought of 2001-2002 impacted all regions of Maryland, streams sampled in the Coastal Plain – western shore region had a more dramatic response with very low flows and standing pools. The explanation for these responses may be due to local geomorphic conditions. Coastal Plain – western shore sentinel sites are located in Charles and St. Mary's County and are situated in the Waldorf Upland Plain District (Reger and Cleaves 2003). The geology in this district is characterized by a limited thickness of unconsolidated coastal plain sediments above a confining unit that limits the exchange of water flow with deeper aquifers. These conditions limit the supply of groundwater for baseflow support during periods of

limited precipitation. Outflow of water from the upper-most unconfined units occurs through flow into stream channels and the uptake resulting from transpiration by vegetation (Dunne and Leopold, 1978). This outflow was likely to have been inadequately replenished through recharge from rainfall during the 2001 to 2002 drought. Conditions in the Coastal Plain – western shore region would have been exacerbated in localized areas dominated by sands and gravels that allow rapid rates of groundwater movement, where stream channels have incised into the landscape, or where there is a shallow fragipan that further limits the thickness of the soil layers capable of storing water for baseflow support. The net result would be a reduction in baseflows in small tributaries.

Most physical and chemical parameters were not dramatically different between years at each sentinel site. The most notable change involved variations in blackwater designation. For example, the unnamed tributary to Emory Creek (CORS-102-S) and the unnamed tributary to Skeleton Creek (UPCK-113-S) underwent changes in blackwater designations, based on the water chemistry definition of a blackwater system. In 2002, neither site met the dissolved organic carbon concentration and pH requirements for blackwater designation, despite having met these criteria in previous years and in 2003 and 2004 (Table 11-3). The low dissolved organic carbon concentrations recorded at these sites occurred during the extended drought period.

These changes in designation indicate that it is important to consider other available data in assigning a blackwater designation. Field observations and site-specific knowledge regarding blackwater conditions can augment the strictly water-chemistry based definition, which uses single-point-in-time data that do not capture natural variations in DOC, pH or ANC levels.

11.7 DISCUSSION

The existing Sentinel Site Network contains some of the best freshwater streams remaining in Maryland (i.e., minimally disturbed and least likely to change in the future from human-related activities) and includes 1st through 3rd order streams within each geographic region. However, there are noticeable differences in the quality of these streams in each of the four geographic regions. The Highlands region contains eight streams with few apparent anthropogenic impacts (Figure 11-2). All eight have excellent water quality, good biological index scores, and a catchment dominated by forested land use (76% or greater; Table 11-3). Conversely, it was difficult to identify sites of comparable quality in the Coastal Plain – western shore, Eastern Piedmont, and especially the Coastal Plain – eastern shore. Although a number of sites in these regions met the minimum criteria for candidate sentinel sites, few were truly high quality. Frequently, anthropogenic impacts (mostly resulting from agricultural land use) were evident to at least some degree. Therefore, it is important to maintain adequate numbers of sentinel sites in all Maryland regions, while recognizing that the quality of sites varies among regions.

The Sentinel Site Network is a valuable tool for interpreting stream conditions over time and making informed decisions on water resources management. One potential use would be to adjust individual site fish and benthic IBI scores relative to the scores obtained at the sentinel

sites. For example, in years where sentinel site scores were consistently low due to natural variation (e.g., the Coastal Plain – western shore region in 2003), random sites sampled that year could have their scores adjusted upward by the amount the sentinel sites were lower than normal. Raw scores would be retained for most analyses, but adjusted scores could be used in water resource management to provide fair assessments across watersheds sampled in different years. At a minimum, water resource managers should realize that index scores during drought periods in certain regions of Maryland can be inherently lower due to natural variation.

Ultimately, the utility of the Sentinel Network will depend upon whether land use changes or other impacts arise in a significant number of sentinel site catchments, thereby reducing the ability of the Network to define natural variability. Future sampling will determine whether high quality conditions continue at the locations included in the Sentinel Site Network.

Ideally, the presence of one or more sentinel sites on county, state, or federal land would influence land use decisions that would protect sentinel site catchments. As needed, sentinel sites may be replaced to ensure that adequate numbers of undisturbed sites are available in each geographic region. We hope that after several years, the Sentinel Site Network will provide an accurate picture of the temporal variability in the best remaining streams in Maryland.

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Table 11-1. Years in which sentinel sites have been sampled in each geographic region.

SITE	STREAM NAME	1995	1996	1997	2000	2001	2002	2003	2004
<i>Coastal Plain – eastern shore</i>									
LOCR-102-S	Swan Creek	X		X	X	X	X	X	X
NASS-108-S	Millville Creek		X	X	X	X	X	X	X
UPCK-113-S	Unnamed tributary to Skeleton Creek		X	X	X	X	X	X	X
WIRH-220-S	Leonard Pond Run	X		X	X	X	X	X	X
CORS-102-S	Unnamed tributary to Emory Creek			X	X	X	X	X	X
NASS-302-S	Nassawango Creek				X	X	X	X	X
<i>Coastal Plain – western shore</i>									
MATT-033-S	Mattawoman Creek	X		X	X	X	X	X	X
NANJ-331-S	Mill Run (Nanjemoy Creek)	X		X	X	X	X	X	X
PAXL-294-S	Swanson Creek		X	X	X	X	X	X	X
PTOB-002-S	Hoghole Run	X		X	X	X	X	X	X
STCL-051-S	Unnamed Tributary to St. Clements Creek	X		X	X	X	X	X	X
ZEKI-012-S	Unnamed Tributary to Zekiah Swamp Run	X		X	X	X	X	X	X
<i>Eastern Piedmont</i>									
JONE-109-S	Unnamed Tributary to Dipping Pond Run	X		X	X	X	X	X	X
JONE-315-S	North Branch Jones Falls		X	X	X	X	X	X	X
LOCH-120-S	Baisman Run		X	X	X	X	X	X	X
RKGR-119-S	Unnamed Tributary to the Patuxent River		X	X	X	X	X	X	X
FURN-101-S	Unnamed Tributary to Principio Creek			X	X	X	X	X	X
LIBE-102-S	Timber Run			X	X	X	X	X	X
<i>Highlands</i>									
FIMI-207-S	Fifteen Mile Creek	X		X	X	X	X	X	X
PRLN-626-S	Mill Run		X	X	X	X	X	X	X
SAVA-204-S	Crabtree Creek			X	X	X	X	X	X
SAVA-225-S	Savage River		X	X	X	X	X	X	X
SAVA-276-S	Double Lick Run		X	X	X	X	X	X	X
UMON-119-S	Buzzard Branch					X	X	X	X
UMON-288-S	High Run		X		X	X	X	X	X
YOUNG-432-S	Bear Creek	X		X	X	X	X	X	X

Table 11-2. Sites sampled in 2004 that met sentinel site screening criteria. MBSS 2004 data are shown.

Site Name	Site Type	Stream Name	County	Order	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	% Shed Forested	FIBI	BIBI	CBI	Blackwater
<i>Coastal Plain – eastern shore</i>														
UPCK-113-S-2004	S	Skeleton Cr	CN	1	6.31	0.254	12.08	14.90	ORG & AD	61.00	4.00	4.14	4.07	Yes
LOCR-102-S-2004	S	Swan Cr	KE	1	5.91	0.064	9.29	15.84	ORG & AD	85.19	†	1.86	1.86	Yes
CORS-102-S-2004	S	Emory Cr UT1	QA	1	6.02	0.222	6.61	16.46	ORG	89.92	†	4.14	4.14	Yes
NASS-108-S-2004	S	Millville Cr	WO	1	4.45	0.027	2.68	25.27	ORG	77.82	†	1.86	1.86	Yes
NASS-302-S-2004	S	Nassawango Cr	WO	3	6.37	0.214	5.47	12.56	ORG	71.66	†	3.57	3.57	Yes
MACK-108-R-2004	R	Marshyhope Cr UT1	CN	1	4.49	0	0.55	29.09	ORG	85.28	†	1.86	1.86	Yes
MACK-110-R-2004	R	Marshyhope Cr UT1	CN	1	4.34	0	0.68	28.74	ORG	87.22	†	2.43	2.43	Yes
TRAN-106-R-2004	R	Middletown Br	DO	1	5.63	0.222	6.26	15.53	ORG	70.92	†	1.86	1.86	Yes
TRAN-112-R-2004	R	Middletown Br	DO	1	5.80	0.244	11.76	12.26	ORG & AD	51.26	†	2.71	2.71	Yes
TRAN-137-R-2004	R	Middletown Br UT	DO	1	4.99	0.289	16.60	15.75	ORG & AD	58.90	†	2.43	2.43	Yes
UPCR-208-R-2004	R	Cypress Br	KE	2	6.17	0.350	6.43	12.16	ORG & AD	60.81	4.00	4.14	4.07	Yes
UPCR-112-R-2004	R	Red Lion Br UT2 UT3	QA	1	6.37	3.896	8.82	1.89	NONE	51.55	3.67	2.71	3.19	No
NEWP-190-E-2004	E	Massey Br	WO	1	4.55	0	3.77	20.07	ORG	99.40	†	2.14	2.14	Yes
<i>Coastal Plain – western shore</i>														
MATT-033-S-2004	S	Mattawoman Cr	CH	3	6.95	0.193	8.09	7.76	NONE	70.03	4.67	4.43	4.55	No
PAXL-294-S-2004	S	Swanson Cr	CH	2	6.69	0.352	14.00	2.78	AD	69.71	3.67	5.00	4.33	No
PTOB-002-S-2004	S	Hoghole Run	CH	2	6.06	0.090	9.53	5.70	AD	83.55	3.67	4.71	4.19	No
ZEKI-012-S-2004	S	Zekiah Swamp Run	CH	1	6.32	0.150	8.55	2.84	AD	92.95	3.33	4.71	4.02	No
STCL-051-S-2004	S	St Clemens Cr UT1	SM	1	6.38	0.303	8.33	5.90	AD	74.93	3.67	5.00	4.33	No
NANJ-331-S-2004	S	Mill Run Nanjemoy Cr	CH	3	5.97	0.187	10.95	4.19	AD	81.25	4	5	4.5	No
PAXU-212-R-2004	R	Stocketts Run	AA	2	6.86	1.087	24.71	1.75	NONE	54.93	3.33	3.57	3.45	No
PAXL-101-R-2004	R	Cypress Swamp Cr UT	CA	1	7.21	0.753	11.88	1.69	NONE	76.91	3.33	4.14	3.74	No
PAXL-111-R-2004	R	Island Cr UT	CA	1	7.45	2.090	11.53	1.91	NONE	71.66	2.33	4.14	3.24	No
PAXL-115-R-2004	R	Indian Cr UT Patuxent R	CH	1	7.07	0.902	10.78	1.70	NONE	85.42	3.33	4.14	3.74	No
PRLT-104-R-2004	R	Potomac R UT29	CH	1	6.80	1.185	15.01	2.25	NONE	75.01	2.00	4.14	3.07	No
PRLT-114-R-2004	R	Mill Run	CH	1	6.30	0.130	8.77	2.22	AD	81.43	3.33	4.14	3.74	No
PRLT-202-R-2004	R	Potomac R UT28	CH	2	6.66	1.101	13.84	4.95	AD	74.17	2.00	4.43	3.21	No
PRMT-105-R-2004	R	Reeder Run UT	CH	1	6.46	0.149	3.48	1.81	AD	92.22	4.67	4.43	4.55	No
PRMT-109-R-2004	R	Potomac R UT25	CH	1	6.31	0.180	10.00	5.21	AD	74.89	3.67	4.71	4.19	No
PRMT-110-R-2004	R	Potomac R UT27	CH	1	6.12	0.007	2.46	3.45	AD	92.93	4.00	3.00	3.50	No
PRMT-118-R-2004	R	Potomac R UT26	CH	1	5.28	0.090	9.95	10.37	ORG & AD	90.80	†	2.14	2.14	Yes
PRMT-206-R-2004	R	Reeder Run UT	CH	2	6.86	0.019	4.91	4.04	NONE	93.06	4.67	3.86	4.26	No
PRMT-207-R-2004	R	Reeder Run UT	CH	2	6.62	0.026	4.50	3.39	NONE	92.88	3.67	3.57	3.62	No
BUSH-114-R-2004	R	Bridge Cr	HA	1	5.72	0	5.85	11.10	ORG & AD	83.85	†	2.43	2.43	Yes

Table 11-2. (Continued)

Site Name	Site Type	Stream Name	County	Order	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	% Sheds Forested	FIBI	BIBI	CBI	Blackwater
BUSH-104-R-2004	R	Bridge Cr	HA	1	5.43	0	4.21	12.34	ORG	86.11	†	2.71	2.71	Yes
PAXL-119-R-2004	R	Patuxent R UT6	PG	1	6.97	0.857	16.53	2.64	NONE	52.43	3.67	3.00	3.33	No
PAXL-125-R-2004	R	Patuxent R UT6	PG	1	7.13	0.983	17.49	1.60	NONE	53.02	2.00	5.00	3.50	No
PAXL-205-R-2004	R	Tom Walls Br	PG	2	6.85	0.907	24.67	2.34	NONE	57.50	3.33	4.43	3.88	No
PAXL-109-R-2004	R	Horse Landing Cr	SM	1	7.62	1.847	14.00	1.58	NONE	51.06	2.00	4.14	3.07	No
PAXL-124-R-2004	R	Horse Landing Cr	SM	1	7.50	1.077	13.23	1.87	NONE	62.16	2.00	4.71	3.36	No
WICO-103-R-2004	R	Burroughs Run	SM	1	6.89	1.494	11.16	1.81	NONE	64.74	1.67	4.71	3.19	No
WICO-113-R-2004	R	Nelsons Run UT	SM	1	6.82	0.683	11.69	2.96	NONE	59.51	4.67	4.43	4.55	No
WICO-207-R-2004	R	Chaptico Cr	SM	2	7.45	1.618	10.57	2.64	NONE	58.18	3.67	4.71	4.19	No
WICO-214-R-2004	R	Coffee Hill Run	SM	2	6.90	0.669	9.83	3.57	AD	73.35	3.67	4.71	4.19	No
WICO-217-R-2004	R	Budds Cr	SM/CH	2	6.76	0.462	11.65	3.83	AD	74.86	3.33	3.57	3.45	No
NCRW-214-N-2004	N	Accokeek Cr	PG	2	7.25	0.122	14.65	4.21	NONE	86.58	4.33	3.29	3.81	No
PAXL-293-E-2004	E	Persimmon Cr	SM	2	6.78	0.166	7.28	4.31	NONE	78.31	4.00	4.14	4.07	No
Eastern Piedmont														
JONE-315-S-2004	S	North Br Jones Falls	BA	3	7.59	1.503	4.88	1.05	NONE	56.29	3.67	4.00	3.83	No
LIBE-102-S-2004	S	Timber Run	BA	1	7.03	1.187	4.80	0.69	NONE	74.67	4.67	4.67	4.67	No
LOCH-120-S-2004	S	Baisman Run	BA	1	7.04	1.718	3.32	0.69	AD	62.99	2.00	4.33	3.17	No
FURN-101-S-2004	S	Principio Cr UT2	CE	1	6.79	0.775	3.52	2.26	AD	86.46	4.00	4.00	4.00	No
RKGR-119-S-2004	S	Patuxent R UT2	HO	1	7.73	1.888	6.47	0.98	NONE	66.76	4.00	4.67	4.33	No
GWYN-102-R-2004	R	Red Run UT2	BA	1	7.90	0.948	12.06	2.88	NONE	87.17	2.67	5.00	3.83	No
OCTO-114-R-2004	R	Basin Run UT1	CE	1	7.38	2.037	10.76	0.98	NONE	53.64	3.00	3.67	3.33	No
CDAM-212-R-2004	R	Peddler Run	HA	2	7.75	0.707	6.19	2.02	NONE	56.40	3.33	4.00	3.67	No
DEER-113-R-2004	R	Thomas Run UT	HA	1	8.60	1.485	13.67	1.30	NONE	62.89	4.00	3.00	3.50	No
DEER-115-R-2004	R	Deer Cr UT1	HA	1	7.64	2.715	10.93	0.79	NONE	52.52	3.67	4.00	3.83	No
DEER-120-R-2004	R	North Stirrup Run UT	HA	1	6.90	1.644	7.29	0.65	NONE	75.29	3.33	4.67	4.00	No
DEER-126-R-2004	R	Wet Stone Br	HA	1	6.91	2.837	2.86	0.44	AD	50.78	4.67	4.33	4.50	No
LSUS-292-E-2004	E	Mill Cr Chesapeake Bay	CE	2	7.31	0.884	6.84	4.55	NONE	63.85	4.00	4.33	4.17	No
Highlands														
FIMI-207-S-2004	S	Fifteenmile Cr	AL	3	7.01	0.546	8.38	0.86	AD	89.51	4.67	4.00	4.33	No
PRLN-626-S-2004	S	Mill Run	AL	2	7.46	1.974	11.48	0.87	NONE	100.00	3.50	4.00	3.75	No
UMON-119-S-2004	S	Buzzard Br	FR	1	7.39	0.430	4.75	1.89	NONE	99.33	3.00	3.25	3.13	No
UMON-288-S-2004	S	High Run	FR	1	6.67	0.241	3.61	0.75	AD	81.63	4.00	4.25	4.13	No
SAVA-204-S-2004	S	Crabtree Cr	GA	2	7.59	0.905	13.62	0.57	NONE	89.30	4.00	3.25	3.63	No
SAVA-225-S-2004	S	Savage R	GA	3	7.40	0.760	10.09	1.27	AD	83.87	4.33	4.25	4.29	No
SAVA-276-S-2004	S	Double Lick Run	GA	1	6.86	0.626	11.22	0.23	AD	92.64	4.50	4.25	4.38	No

Table 11-2. (Continued)

Site Name	Site Type	Stream Name	County	Order	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	% Shed Forested	FIBI	BIBI	CBI	Blackwater
YOUNG-432-S-2004	S	Bear Cr	GA	3	7.24	0.600	8.30	1.43	AD	76.25	4.67	4.50	4.58	No
EVIT-101-R-2004	R	Hazen Run	AL	1	7.85	1.301	13.10	1.12	NONE	97.04	4.50	2.50	3.50	No
EVIT-303-R-2004	R	Evitts Cr	AL	3	8.11	0.732	15.33	1.76	NONE	79.63	5.00	2.75	3.88	No
EVIT-311-R-2004	R	Evitts Cr	AL	3	8.36	0.738	15.16	1.70	NONE	79.69	4.67	3.00	3.83	No
WILL-120-R-2004	R	Braddock Run UT2	AL	1	7.41	1.603	16.50	1.14	NONE	92.43	2.50	4.75	3.63	No
WILL-404-R-2004	R	Wills Cr	AL	4	7.61	1.208	28.31	0.73	NONE	79.89	4.33	3.75	4.04	No
PRFR-112-R-2004	R	Little Catoctin Cr UT2	FR	1	7.28	2.010	7.23	3.11	NONE	50.96	‡	3.25	3.25	No
LCON-107-R-2004	R	Lanes Run UT1	WA	1	7.60	0.295	10.75	1.52	NONE	83.35	3.67	3.25	3.46	No
LCON-119-R-2004	R	Little Conococheague Cr UT2	WA	1	7.14	0.948	6.01	0.81	AD	99.52	3.33	3.75	3.54	No
LCON-204-R-2004	R	Little Conococheague Cr	WA	2	7.56	0.591	6.92	1.31	NONE	87.15	4.33	2.25	3.29	No
LCON-209-R-2004	R	Little Conococheague Cr	WA	2	8.00	1.908	9.67	1.30	NONE	53.69	4.67	3.25	3.96	No
LIKIG-103-R-2004	R	Lanes Run	WA	1	6.88	0.704	5.54	0.85	AD	99.43	3.67	3.75	3.71	No
LIKIG-211-R-2004	R	Rattle Run UT	WA	2	7.16	0.275	8.11	0.96	AD	99.95	1.67	5.00	3.33	No
PRFR-103-R-2004	R	Israel Cr	WA	1	7.41	1.757	11.45	1.31	NONE	53.88	3.67	3.25	3.46	No
NCRW-305-N-2004	N	Seven Springs Run	AL	3	7.83	0.224	24.18	2.05	NONE	88.88	5.00	3.00	4.00	No
NCRW-107-N-2004	N	Israel Cr	WA	1	7.85	1.371	11.62	1.33	NONE	64.03	4.00	3.25	3.63	No
NCRW-206-N-2004	N	Green Spring Run	WA	2	8.45	0.368	14.51	1.64	NONE	88.58	4.67	3.00	3.83	No
YOUNG-399-E-2004	E	Bear Cr	GA	3	7.35	1.101	10.49	0.83	ORG	73.12	4.67	4.00	4.33	No

Notes

Site Type: S = sentinel site; R = randomly-selected site; E = randomly-selected EPA site; N = randomly-selected National Park Service site.

* pH determined by laboratory analysis during spring sampling

Acid Source: ORG = organic acid source; AD = acid deposition

† FIBI value not reported if less than 3.00 for designated blackwater streams.

‡ FIBI value not calculated for streams with catchment areas less than 300 acres.

Counties:

AA = Anne Arundel	CH = Charles	KE = Kent
AL = Allegany	DO = Dorchester	PG = Prince George's
BA = Baltimore	FR = Frederick	QA = Queen Anne's
CA = Calvert	GA = Garrett	SM = St. Mary's
CN = Caroline	HA = Harford	WA = Washington
CE = Cecil	HO = Howard	WO = Worcester

Table 11-3. Comparisons of MBSS Round 1 and Round 2 results for selected parameters at sentinel sites.

SITE (95-97)	SITE (00-04)	Stream Name	Order	% Forested‡	Year	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	FIBI	BIBI	CBI	Blackwater
<i>Coastal Plain – eastern shore</i>														
KE-N-096-102-95	LOCR-102-S	Swan Creek	1	85.19	1995	5.86	0.120	17.46	20.00	ORG & AD	3.00	2.71	2.86	Yes
					2000	6.02	0.085	4.94	33.18	ORG	†	1.86	1.86	Yes
					2001	5.92	0.169	7.82	20.15	ORG	†	2.71	2.71	Yes
					2002	5.82	0.072	24.62	15.86	ORG & AD	†	3.29	3.29	Yes
					2003	5.79	0.029	7.85	24.92	ORG	†	3.00	3.00	Yes
					2004	5.91	0.064	9.29	15.84	ORG & AD	†	1.86	1.86	Yes
WO-S-038-108-97	NASS-108-S	Millville Creek	1	77.82	1997	4.40	0.350	3.99	32.90	ORG	†	2.43	2.43	Yes
					2000	4.41	0.082	3.41	36.06	ORG	†	2.14	2.14	Yes
					2001	4.36	0.182	5.48	27.63	ORG	†	2.43	2.43	Yes
					2002	4.40	0.032	11.12	18.63	ORG & AD	†	1.00	1.00	Yes
					2003	4.40	0.004	5.10	29.90	ORG	†	1.57	1.57	Yes
					2004	4.45	0.027	2.68	25.27	ORG	†	1.86	1.86	Yes
CN-N-024-113-96	UPCK-113-S	Skeleton Creek	1	61.00	1996	5.95	0.600	15.90	15.90	ORG & AD	†	3.86	3.86	Yes
					2000	5.53	0.117	6.41	28.63	ORG	†	3.00	3.00	Yes
					2001	6.12	0.303	10.98	17.41	ORG & AD	†	4.43	4.43	Yes
					2002	6.84	0.361	24.11	3.54	NONE	3.33	3.86	3.60	No
					2003	6.10	0.109	10.97	21.17	ORG & AD	†	4.43	4.43	Yes
					2004	6.31	0.254	12.08	14.90	ORG & AD	4.00	4.14	4.07	Yes
WI-S-063-220-95	WIRH-220-S	Leonard Pond Run	2	51.41	1995	6.64	2.080	5.28	6.00	NONE	3.33	4.43	3.88	No
					2000	6.23	0.548	1.73	16.03	ORG	4.00	4.43	4.21	Yes
					2001	6.76	3.860	5.14	3.65	NONE	3.67	4.71	4.19	No
					2002	6.87	6.185	6.62	1.96	NONE	3.67	4.43	4.05	No
					2003	6.50	2.453	6.24	6.10	NONE	3.33	4.14	3.74	No
					2004	6.68	4.328	5.40	3.66	NONE	3.33	4.43	3.88	No
---	CORS-102-S	Emory Creek UT1	1	89.92	2000	6.35	0.164	5.44	17.38	ORG	†	4.14	4.14	Yes
					2001	6.56	0.440	8.24	8.68	ORG & AD	†	4.43	4.43	Yes
					2002	6.80	0.233	27.51	6.52	NONE	2.43	2.43	No	
					2003	6.44	0.166	8.80	14.17	ORG & AD	†	4.14	4.14	Yes
					2004	6.02	0.222	6.61	16.46	ORG	†	4.14	4.14	Yes
---	NASS-302-S	Nassawango Creek	3	71.66	2001	6.25	0.252	7.30	12.20	ORG & AD	4.67	3.57	4.12	Yes
					2002	6.52	0.001	8.62	10.68	NONE	4.67	5.00	4.83	No
					2003	5.87	0.174	5.12	19.27	ORG	4.67	4.71	4.69	Yes
					2004	6.37	0.214	5.47	12.56	ORG	†	3.57	3.57	Yes

Table 11-3. (Continued)

SITE (95-97)	SITE (00-04)	Stream Name	Order	% Forested‡	Year	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	FIBI	BIBI	CBI	Blackwater
<i>Coastal Plain – western shore</i>														
CH-S-033-314-95	MATT-033-S	Mattawoman Creek	3	70.03	1995	6.60	0.240	12.84	4.00	AD	3.67	2.71	3.19	No
					2000	6.73	0.137	9.47	6.96	AD	3.33	3.86	3.60	No
					2001	6.72	0.115	11.13	3.50	AD	3.67	3.86	3.76	No
					2002	6.58	0.122	14.34	6.01	AD	3.67	4.14	3.90	No
					2003	6.46	0.247	16.21	3.66	AD	3.67	3.00	3.33	No
					2004	6.95	0.193	8.09	7.76	NONE	4.67	4.43	4.55	No
CH-S-331-304-95	NANJ-331-S	Mill Run (Nanjemoy Creek)	3	81.25	1995	6.46	0.330	11.61	3.00	AD	4.67	4.43	4.55	No
					2000	6.47	0.164	10.63	3.09	AD	4.00	3.86	3.93	No
					2001	6.66	0.236	10.84	1.65	AD	3.67	4.71	4.19	No
					2002	6.60	0.090	9.92	3.14	AD	3.67	4.71	4.19	No
					2003	6.14	0.388	14.91	2.00	AD	2.33	3.29	2.81	No
					2004	5.97	0.187	10.95	4.19	AD	4.00	5.00	4.50	No
CH-S-294-236-97	PAXL-294-S	Swanson Creek	2	69.71	1997	6.85	0.600	14.76	2.50	AD	4.33	4.43	4.38	No
					2000	6.70	0.313	14.74	3.11	AD	3.33	4.43	3.88	No
					2001	6.94	0.424	14.80	1.86	AD	3.33	4.71	4.02	No
					2002	6.83	0.213	15.37	3.77	NONE	4.33	4.43	4.38	No
					2003	6.46	0.536	17.54	2.95	AD	2.33	4.43	3.38	No
					2004	6.69	0.352	14.00	2.78	AD	3.67	5.00	4.33	No
CH-S-002-207-95	PTOB-002-S	Hoghole Run	2	83.55	1995	6.62	0.200	10.51	3.00	AD	4.67	4.71	4.69	No
					2000	6.46	0.000	9.93	3.45	AD	4.33	4.71	4.52	No
					2001	6.59	0.001	9.79	1.52	AD	4.00	4.14	4.07	No
					2002	6.62	0.036	7.71	3.66	AD	4.00	4.71	4.36	No
					2003	6.04	0.019	14.04	2.39	AD	1.00	3.29	2.14	No
					2004	6.06	0.090	9.53	5.70	AD	3.67	4.71	4.19	No
SM-S-051-132-95	STCL-051-S	St Clements Creek UT1	1	74.93	1995	6.86	0.200	7.05	4.00	NONE	4.33	4.71	4.52	No
					2000	7.03	0.000	6.05	3.44	NONE	3.33	4.43	3.88	No
					2001	6.96	0.001	6.56	2.56	NONE	3.67	5.00	4.33	No
					2002	7.06	0.001	5.58	3.44	NONE	3.33	4.14	3.74	No
					2003	6.77	0.021	8.78	2.94	NONE	3.67	4.43	4.05	No
					2004	6.38	0.303	8.33	5.90	AD	3.67	5.00	4.33	No
CH-S-012-114-95	ZEKI-012-S	Zekiah Swamp Run UT1	1	92.95	1995	6.20	0.340	14.82	3.00	AD	3.67	4.71	4.19	No
					2000	6.52	0.079	7.88	2.57	AD	3.67	4.71	4.19	No
					2001	6.66	0.214	7.36	1.74	AD	4.33	4.71	4.52	No
					2002	6.81	0.096	8.74	4.14	NONE	3.67	4.43	4.05	No
					2003	6.44	0.107	10.23	2.15	AD	1.33	3.86	2.60	No
					2004	6.32	0.150	8.55	2.84	AD	3.33	4.71	4.02	No

Table 11-3. (Continued)

SITE (95-97)	SITE (00-04)	Stream Name	Order	% Forested‡	Year	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	FIBI	BIBI	CBI	Blackwater
<i>Eastern Piedmont</i>														
BA-P-234-109-95	JONE-109-S	Dipping Pond Run UT1	1	76.78	1995	6.77	2.510	2.09	1.00	NONE	1.67	4.67	3.17	No
					2000	6.41	2.386	2.66	0.79	NONE	1.33	4.67	3.00	No
					2001	6.67	2.921	1.14	1.09	NONE	1.33	5.00	3.17	No
					2002	6.41	3.169	1.25	0.95	NONE	1.33	4.33	2.83	No
					2003	6.34	2.649	3.82	1.00	NONE	1.33	4.33	2.83	No
					2004	6.68	2.756	2.54	0.35	NONE	1.67	3.67	2.67	No
BA-P-077-315-96	JONE-315-S	North Br Jones Falls	3	56.29	1996	7.60	1.320	7.36	2.60	NONE	4.33	4.67	4.50	No
					2000	7.52	1.066	6.17	2.01	NONE	4.00	5.00	4.50	No
					2001	8.20	1.522	4.30	1.13	NONE	4.00	4.00	4.00	No
					2002	8.05	0.960	5.60	1.78	NONE	4.33	4.67	4.50	No
					2003	7.50	1.167	7.77	2.24	NONE	3.33	4.67	4.00	No
					2004	7.59	1.503	4.88	1.05	NONE	3.67	4.00	3.83	No
BA-P-015-120-96	LOCH-120-S	Baisman Run	1	62.99	1996	6.97	2.550	3.99	1.10	AD	2.00	5.00	3.50	No
					2000	7.01	1.075	4.92	0.99	AD	2.67	4.33	3.50	No
					2001	7.14	1.658	2.89	0.79	AD	2.67	5.00	3.83	No
					2002	7.32	1.594	2.20	1.13	NONE	2.33	5.00	3.67	No
					2003	7.01	1.655	6.46	1.02	AD	2.33	4.00	3.17	No
					2004	7.04	1.718	3.32	0.69	AD	2.00	4.33	3.17	No
HO-P-228-119-97	RKGR-119-S	Patuxent River UT2	1	66.76	1997	7.69	1.360	7.17	1.50	NONE	3.67	4.33	4.00	No
					2000	7.49	1.205	7.59	1.56	NONE	4.00	4.33	4.17	No
					2001	6.81	1.648	5.92	1.08	NONE	4.67	5.00	4.83	No
					2002	7.88	1.599	5.78	1.40	NONE	4.33	4.00	4.17	No
					2003	7.56	1.456	7.68	1.34	NONE	3.67	4.33	4.00	No
					2004	7.73	1.888	6.47	0.98	NONE	4.00	4.67	4.33	No
--	FURN-101-S	Principio Creek UT2	1	86.46	2000	6.66	0.509	4.06	2.22	AD	4.00	5.00	4.50	No
					2001	6.78	0.622	4.88	3.07	AD	4.00	4.67	4.33	No
					2002	6.91	0.656	4.62	2.49	AD	4.67	5.00	4.83	No
					2003	6.65	0.516	5.61	3.26	AD	3.33	4.67	4.00	No
					2004	6.79	0.775	3.52	2.26	AD	4.00	4.00	4.00	No
--	LIBE-102-S	Timber Run	1	74.67	2000	6.97	1.126	4.83	0.94	NONE	5.00	5.00	5.00	No
					2001	7.14	1.272	4.27	1.14	NONE	4.67	5.00	4.83	No
					2002	7.01	1.210	4.27	1.21	NONE	5.00	4.33	4.67	No
					2003	6.55	1.265	6.24	2.39	AD	3.67	4.33	4.00	No
					2004	7.03	1.187	4.80	0.69	NONE	4.67	4.67	4.67	No

Table 11-3. (Continued)

SITE (95-97)	SITE (00-04)	Stream Name	Order	% Forested‡	Year	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	FIBI	BIBI	CBI	Blackwater
<i>Highlands</i>														
AL-A-207-307-95	FIMI-207-S	Fifteenmile Creek	3	89.51	1995	6.91	0.260	10.34	2.00	AD	3.67	4.00	3.83	No
					2000	7.09	0.196	9.02	2.21	AD	5.00	3.75	4.38	No
					2001	7.10	0.402	8.79	0.90	AD	5.00	3.75	4.38	No
					2002	7.28	0.256	11.78	1.49	NONE	5.00	4.00	4.50	No
					2003	7.14	0.301	9.51	1.20	AD	5.00	4.50	4.75	No
					2004	7.01	0.546	8.38	0.86	AD	4.67	4.00	4.33	No
AL-A-626-216-96	PRLN-626-S	Mill Run	2	100.00	1996	7.51	0.680	12.89	1.10	NONE	4.00	3.50	3.75	No
					2000	7.56	0.443	13.17	0.99	NONE	3.50	5.00	4.25	No
					2001	7.67	0.841	12.19	0.88	NONE	3.50	4.25	3.88	No
					2002	7.16	1.888	13.21	1.62	NONE	3.50	4.50	4.00	No
					2003	7.59	1.141	13.29	1.08	NONE	4.00	5.00	4.50	No
					2004	7.46	1.974	11.48	0.87	NONE	3.50	4.00	3.75	No
--	SAVA-204-S	Crabtree Creek	2	89.30	2000	7.55	0.392	13.20	0.91	NONE	4.00	4.25	4.13	No
					2001	7.37	0.707	12.91	0.58	NONE	4.67	4.50	4.58	No
					2002	6.93	0.791	14.10	0.89	AD	5.00	5.00	5.00	No
					2003	7.66	0.519	14.27	0.71	NONE	4.67	4.50	4.58	No
					2004	7.59	0.905	13.62	0.57	NONE	4.00	3.25	3.63	No
GA-A-999-302-96	SAVA-225-S	Savage River	3	83.87	1996	7.07	0.800	12.03	1.50	AD	4.33	4.50	4.42	No
					2000	7.26	0.452	11.61	2.45	AD	4.67	4.75	4.71	No
					2001	7.22	0.917	10.40	1.17	AD	5.00	3.50	4.25	No
					2002	7.21	0.871	12.28	2.57	AD	5.00	4.50	4.75	No
					2003	7.11	0.995	11.52	1.90	AD	5.00	4.25	4.63	No
					2004	7.40	0.760	10.09	1.27	AD	4.33	4.25	4.29	No
GA-A-276-106-96	SAVA-276-S	Double Lick Run	1	92.64	1996	6.77	0.490	12.89	0.80	AD	5.00	4.50	4.75	No
					2000	6.75	0.329	12.11	0.70	AD	5.00	4.50	4.75	No
					2001	6.76	0.542	10.70	0.28	AD	5.00	4.25	4.63	No
					2002	6.46	0.570	11.63	0.55	AD	5.00	4.50	4.75	No
					2003	6.70	0.557	11.31	0.35	AD	5.00	4.25	4.63	No
					2004	6.86	0.626	11.22	0.23	AD	4.50	4.25	4.38	No
FR-P-288-133-96	UMON-288-S	High Run	1	81.63	1996	7.33	0.560	6.49	1.70	NONE	2.50	3.00	2.75	No
					2000	6.52	0.163	3.65	1.60	AD	4.00	4.50	4.25	No
					2001	6.52	0.396	3.66	0.68	AD	4.00	4.75	4.38	No
					2002	6.87	0.227	3.19	1.16	AD	4.00	4.50	4.25	No
					2003	6.54	0.321	4.62	1.38	AD	4.00	5.00	4.50	No
					2004	6.67	0.241	3.61	0.75	AD	4.00	4.25	4.13	No

Table 11-3. (Continued)

SITE (95-97)	SITE (00-04)	Stream Name	Order	% Forested‡	Year	pH*	NO ₃ (mg/L)	SO ₄ (mg/L)	DOC (mg/L)	Acid Source	FIBI	BIBI	CBI	Blackwater
---	UMON-119-S	Buzzard Branch	1	99.33	2000	7.05	0.139	5.76	1.84	NONE	3.00	3.75	3.38	No
					2002	7.46	0.189	8.35	2.74	NONE	3.00	5.00	4.00	No
					2003	7.25	0.387	7.13	2.32	NONE	3.00	4.25	3.63	No
					2004	7.39	0.430	4.75	1.89	NONE	3.00	3.25	3.13	No
GA-A-432-315-95	YOUNG-432-S	Bear Creek	3	76.25	1995	6.96	0.650	9.59	1.00	AD	4.67	3.75	4.21	No
					2000	7.01	0.788	9.77	2.33	AD	4.00	4.75	4.38	No
					2001	6.47	1.023	8.59	0.96	AD	4.33	4.50	4.42	No
					2002	7.11	1.234	9.61	1.44	AD	4.00	4.75	4.38	No
					2003	7.10	0.738	8.37	0.80	AD	4.67	4.25	4.46	No
					2004	7.24	0.600	8.30	1.43	AD	4.67	4.50	4.58	No

Notes

* pH determined by laboratory analysis during spring sampling

Acid Source: ORG = organic acid source; AD = acid deposition

† FIBI value not reported if less than 3.00 for designated blackwater streams.

‡ Percentage of catchment upstream of site that is forested

Table 11-4. Mean annual IBIs for sentinel sites by region for Round 2 of the MBSS.

Region	2000	2001	2002	2003	2004	Greatest difference (highest year and lowest year)
<i>FIBI</i>						
Coastal Plain – eastern shore	4.00	4.17	3.89	4.00	3.67	0.50 (2001 and 2004)
Coastal Plain – western shore	3.67	3.67	3.78	2.39	3.83	1.44 (2004 and 2003)
Eastern Piedmont	3.50	3.56	3.67	2.94	3.33	0.72 (2002 and 2003)
Highlands	4.31	4.50	4.31	4.42	4.08	0.42 (2001 and 2004)
<i>BIBI</i>						
Coastal Plain – eastern shore	3.11	3.71	3.33	3.67	3.33	0.60 (2001 and 2000)
Coastal Plain – western shore	4.33	4.49	4.43	3.71	4.81	1.10 (2004 and 2003)
Eastern Piedmont	4.72	4.78	4.56	4.39	4.22	0.56 (2001 and 2004)
Highlands	4.50	4.21	4.59	4.50	3.97	0.63 (2002 and 2004)
<i>CBI</i>						
Coastal Plain – eastern shore	3.07	3.72	3.20	3.60	3.23	0.65 (2001 and 2000)
Coastal Plain – western shore	4.00	4.08	4.10	3.05	4.32	1.27 (2004 and 2003)
Eastern Piedmont	4.11	4.17	4.11	3.67	3.78	0.50 (2001 and 2003)
Highlands	4.40	4.36	4.45	4.46	4.03	0.43 (2003 and 2004)

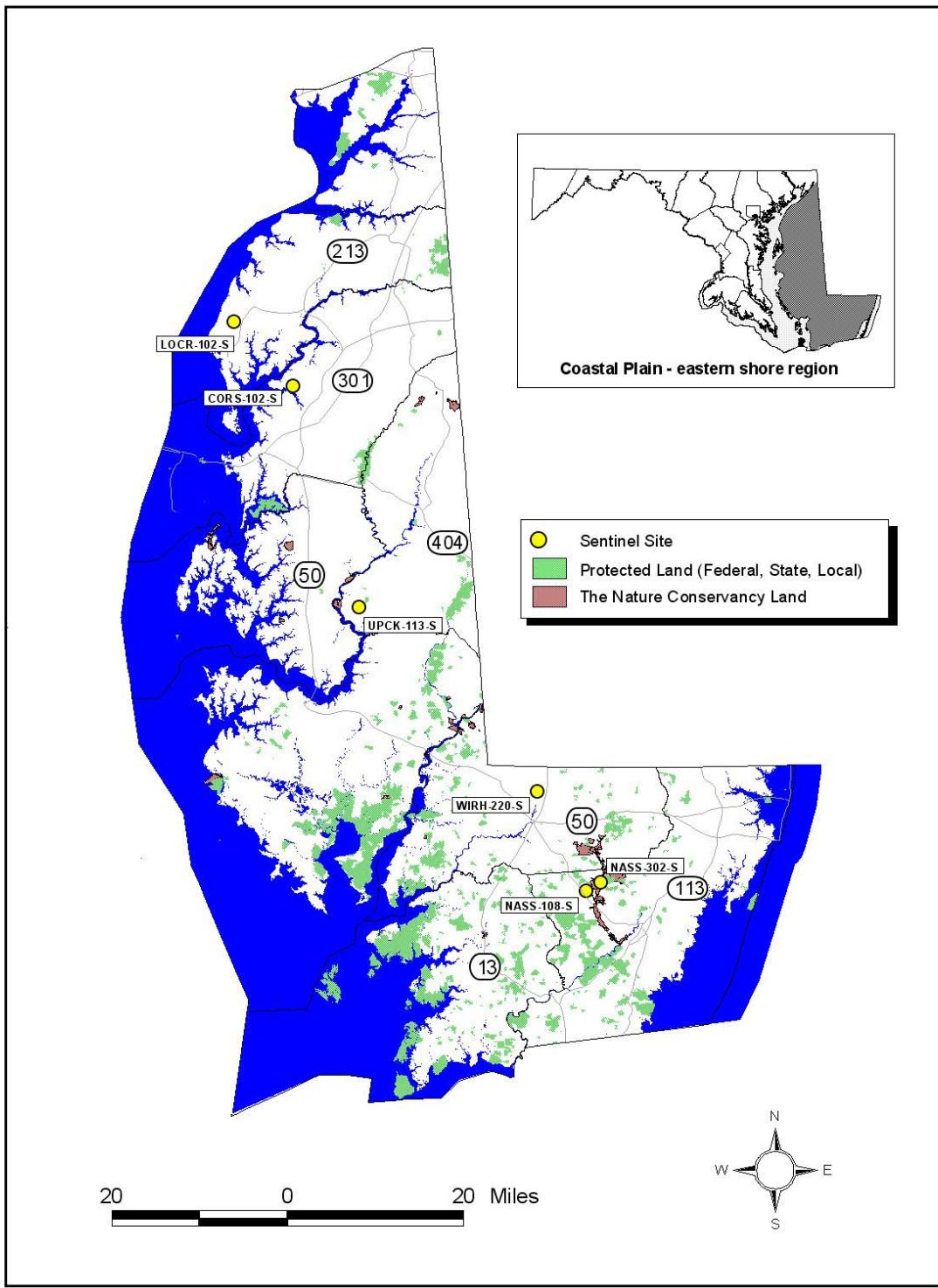
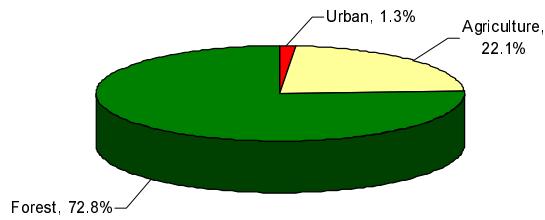
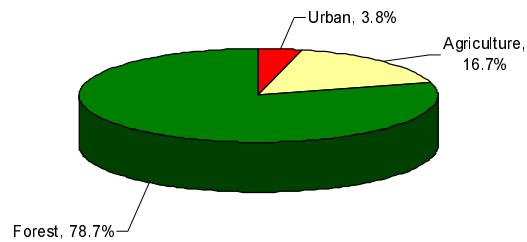


Figure 11-1. Locations of sentinel sites in the Coastal Plain – eastern shore region of Maryland.

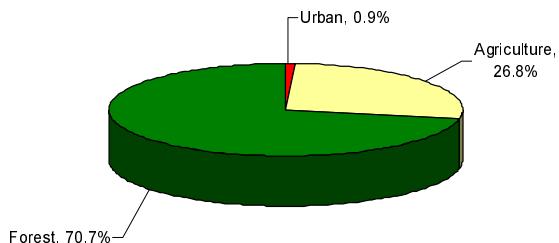
Coastal Plain – eastern shore



Coastal Plain – western shore



Eastern Piedmont



Highlands

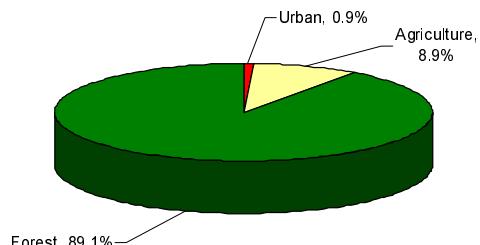


Figure 11-2. Average land use categories for sentinel sites by region (Vogelmann et al. 2001).

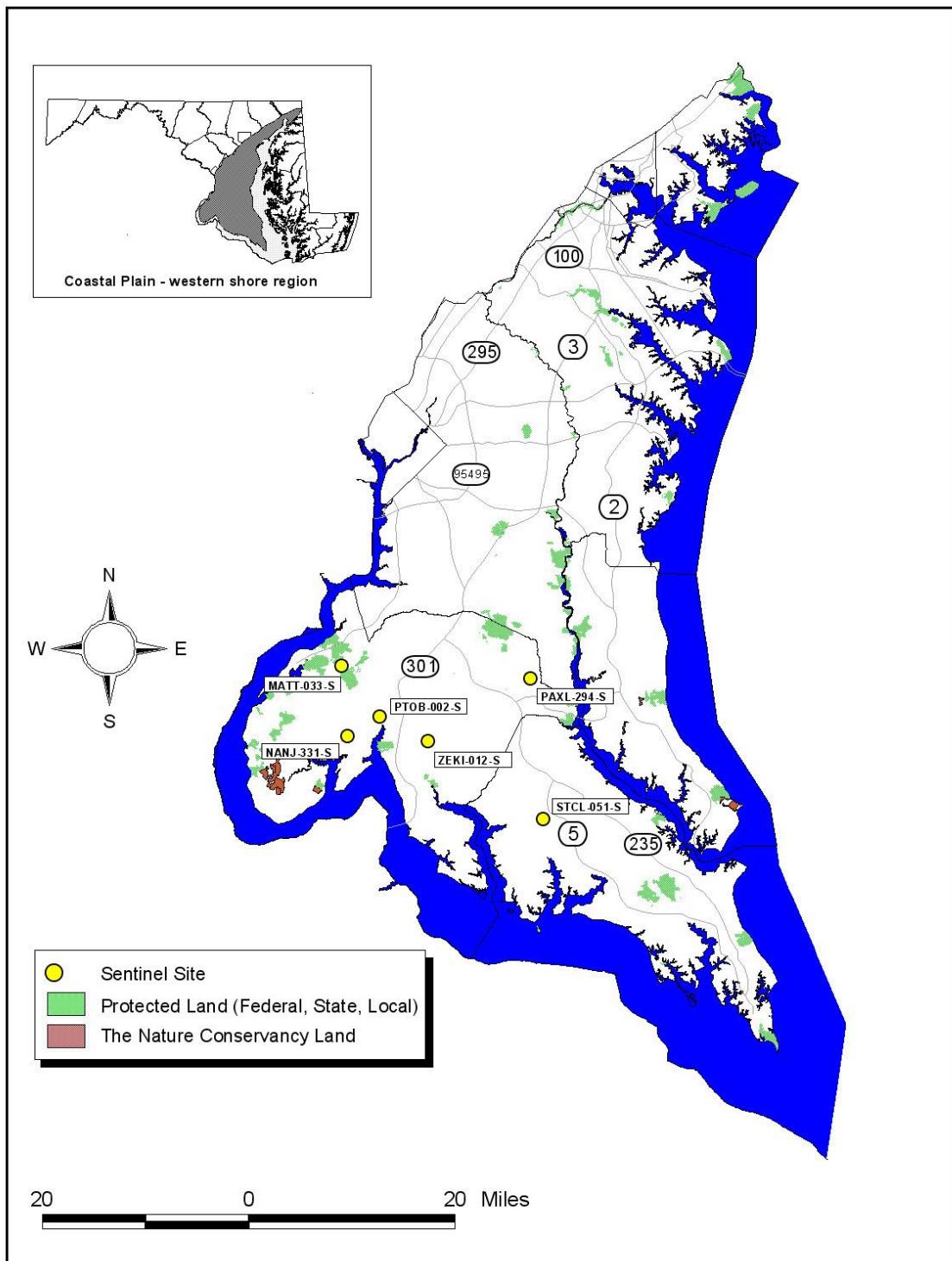


Figure 11-3. Locations of sentinel sites in the Coastal Plain – western shore region of Maryland.

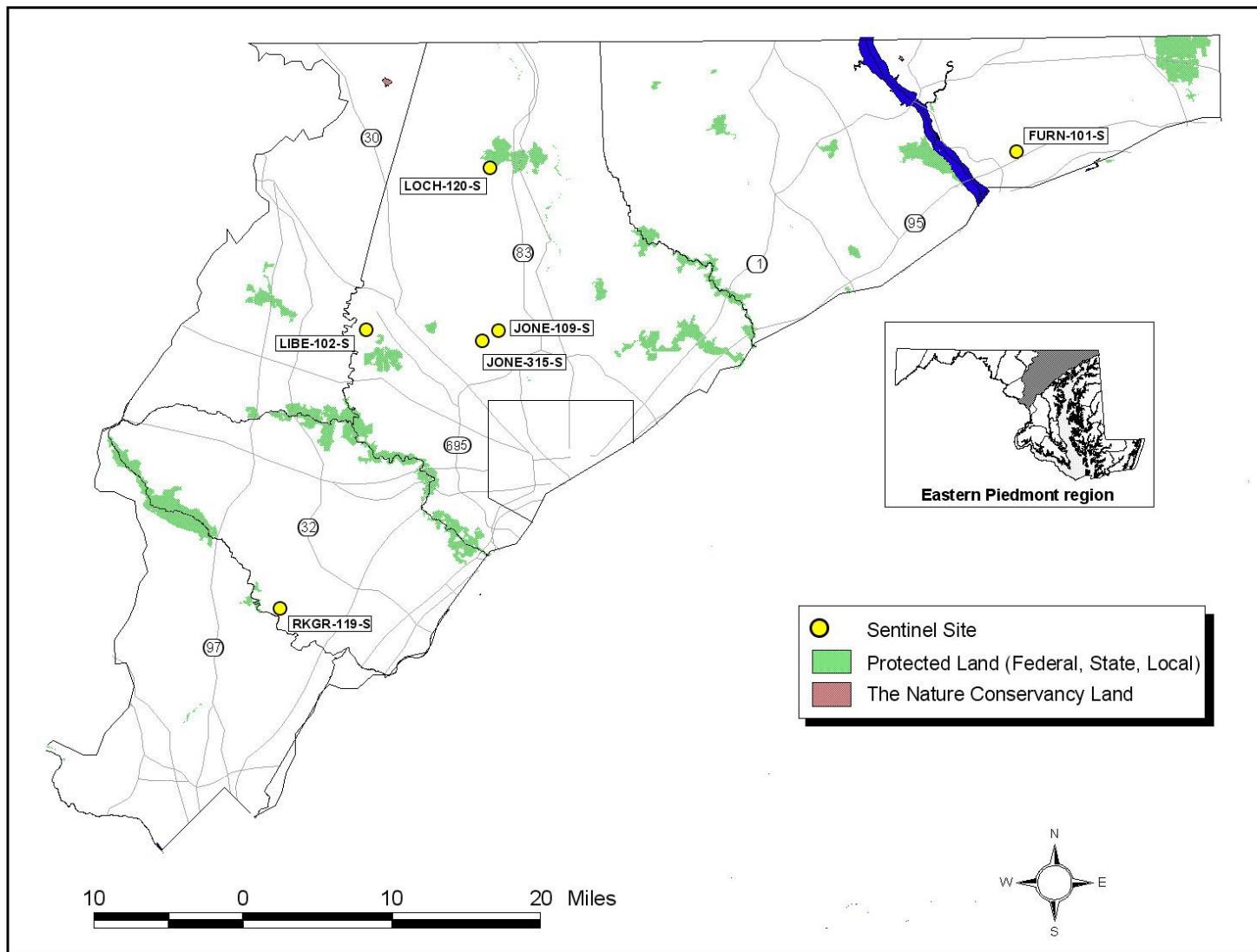


Figure 11-4. Locations of sentinel sites in the Eastern Piedmont region of Maryland.

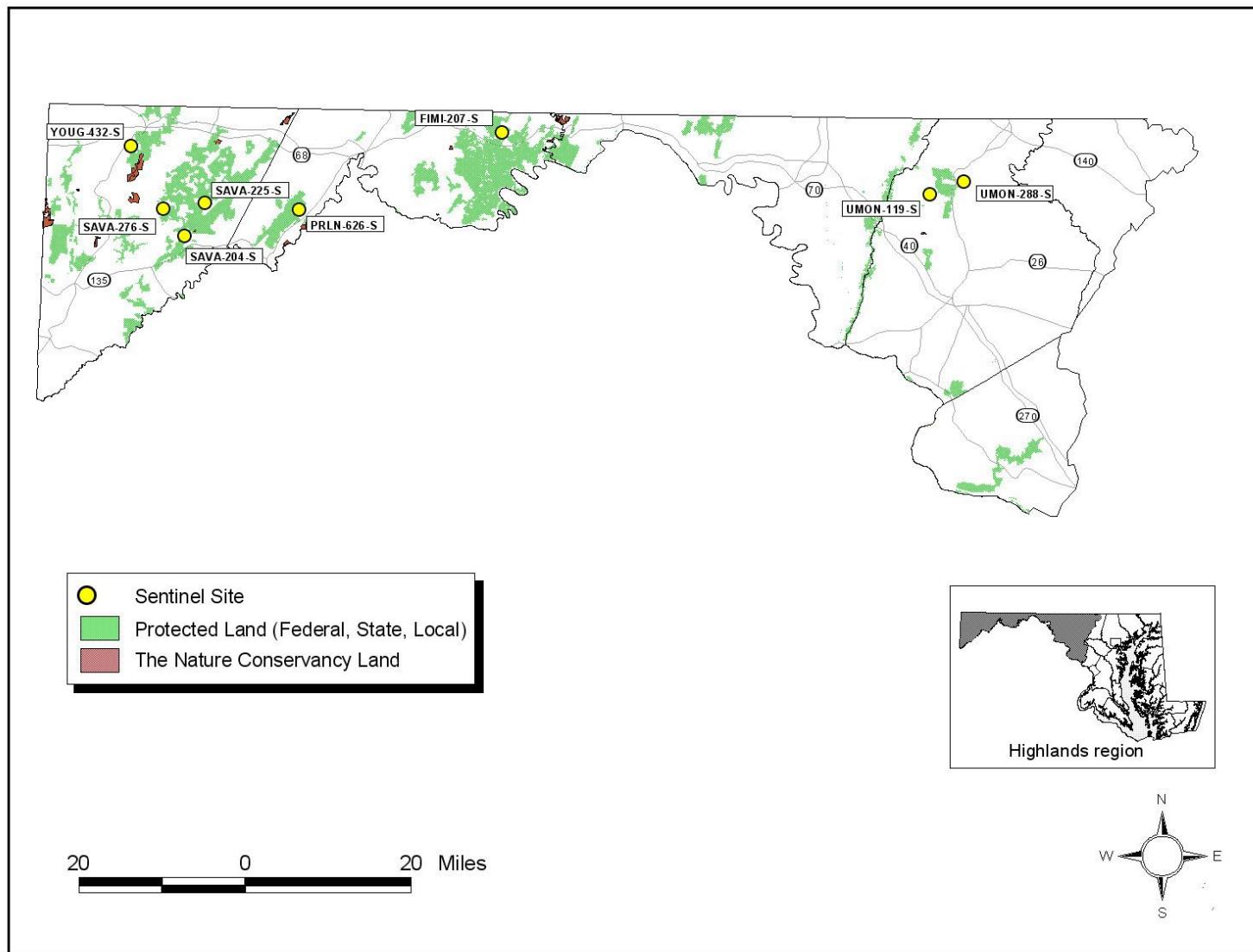


Figure 11-5. Locations of sentinel sites in the Highlands region of Maryland.

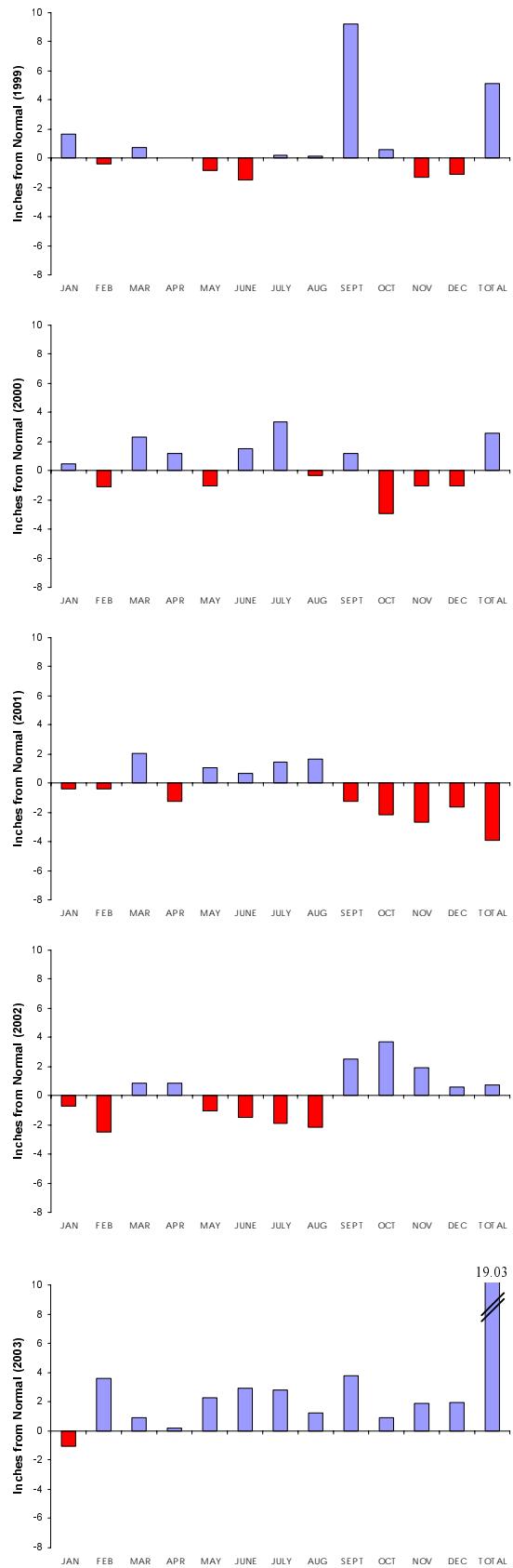


Figure 11-6. Annual precipitation summaries for the Coastal Plain – eastern shore region of Maryland (precipitation summaries calculated from eight NOAA stations).

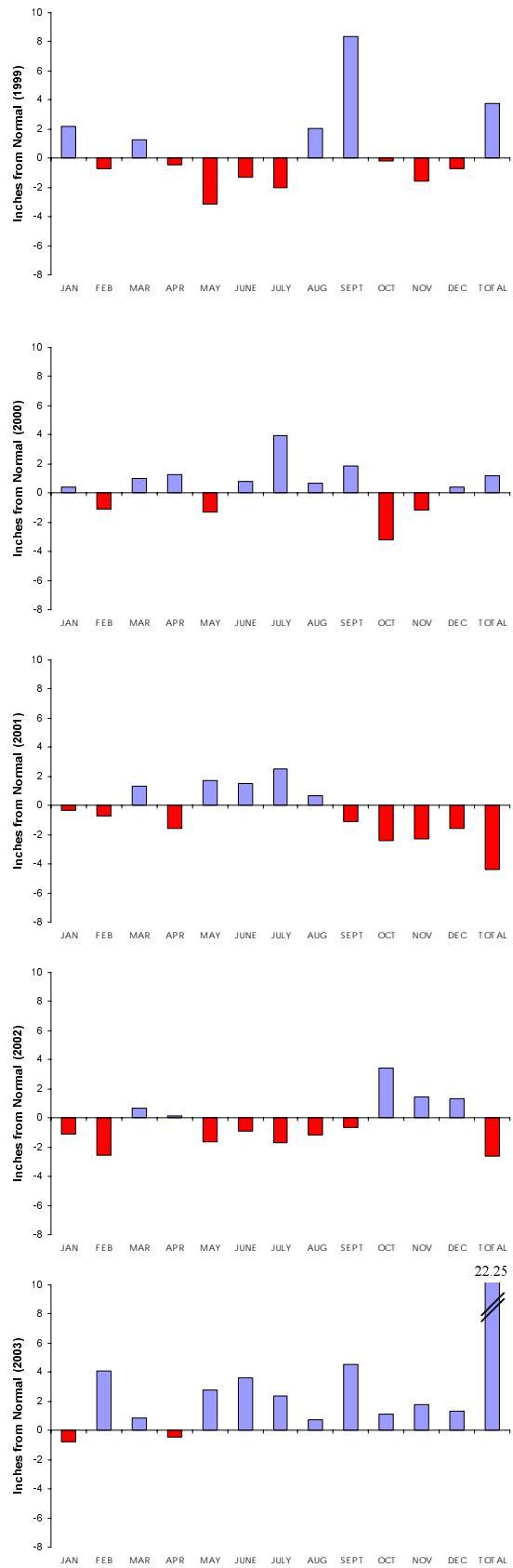


Figure 11-7. Annual precipitation summaries for the Coastal Plain – western shore region of Maryland (precipitation summaries calculated from 10 NOAA stations).

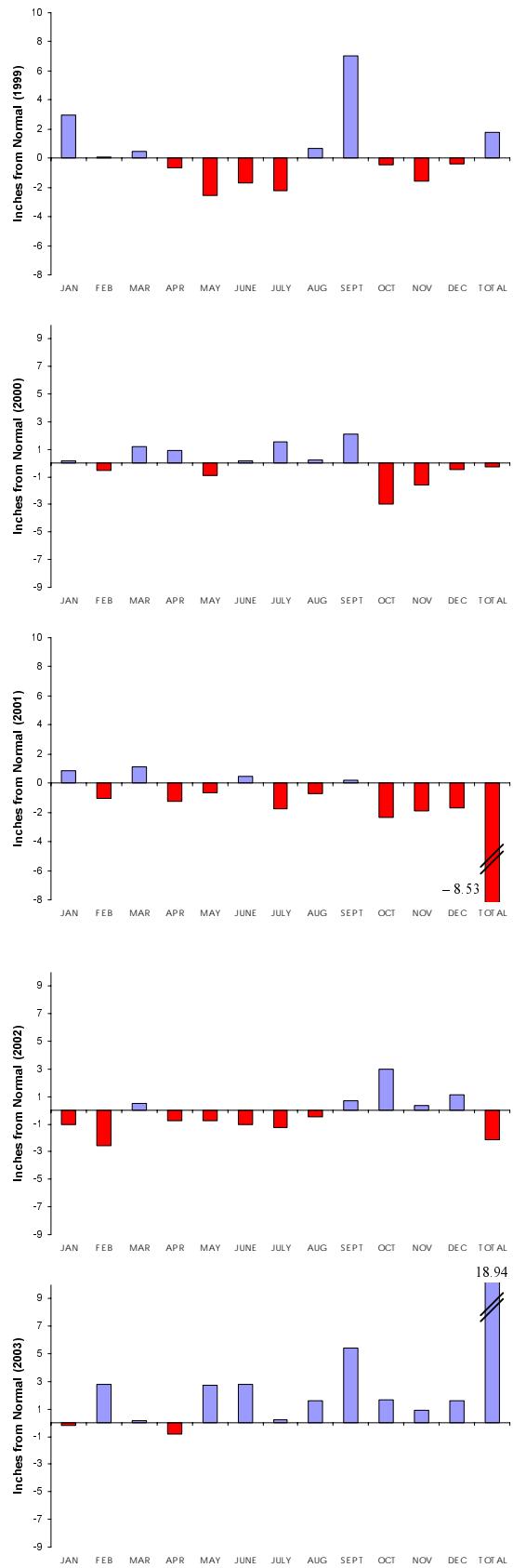


Figure 11-8. Annual precipitation summaries for the Eastern Piedmont region of Maryland (precipitation summaries calculated from 10 NOAA stations).

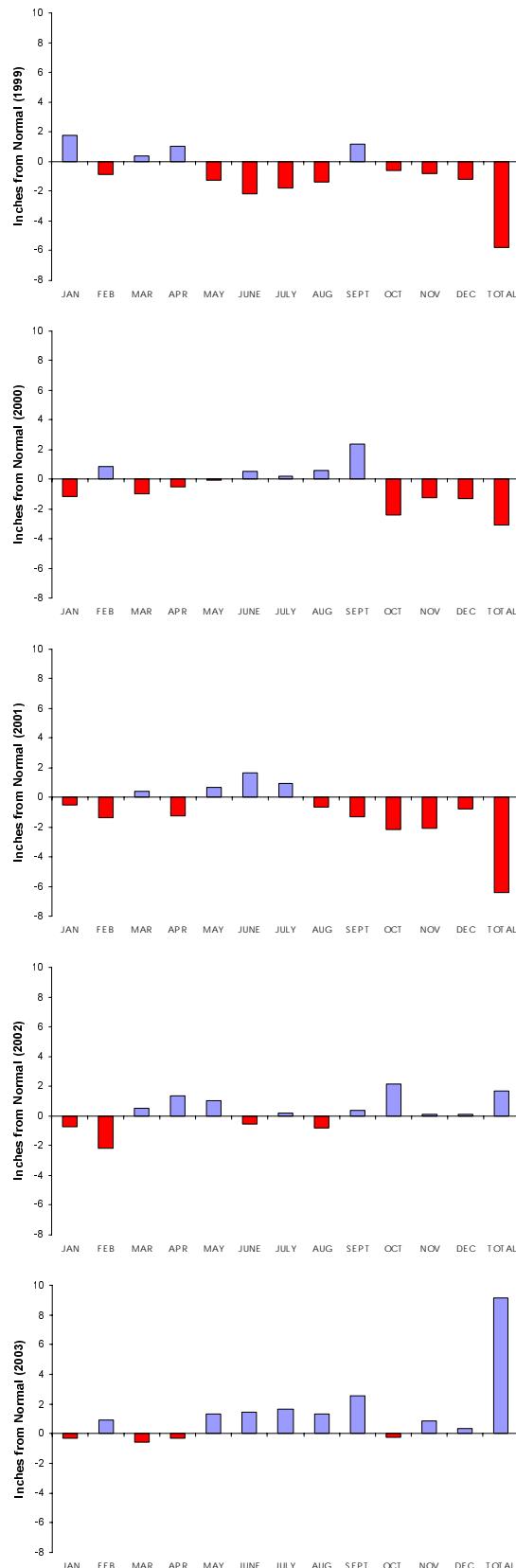


Figure 11-9. Annual precipitation summaries for the Highlands region of Maryland (precipitation summaries calculated from seven NOAA stations).

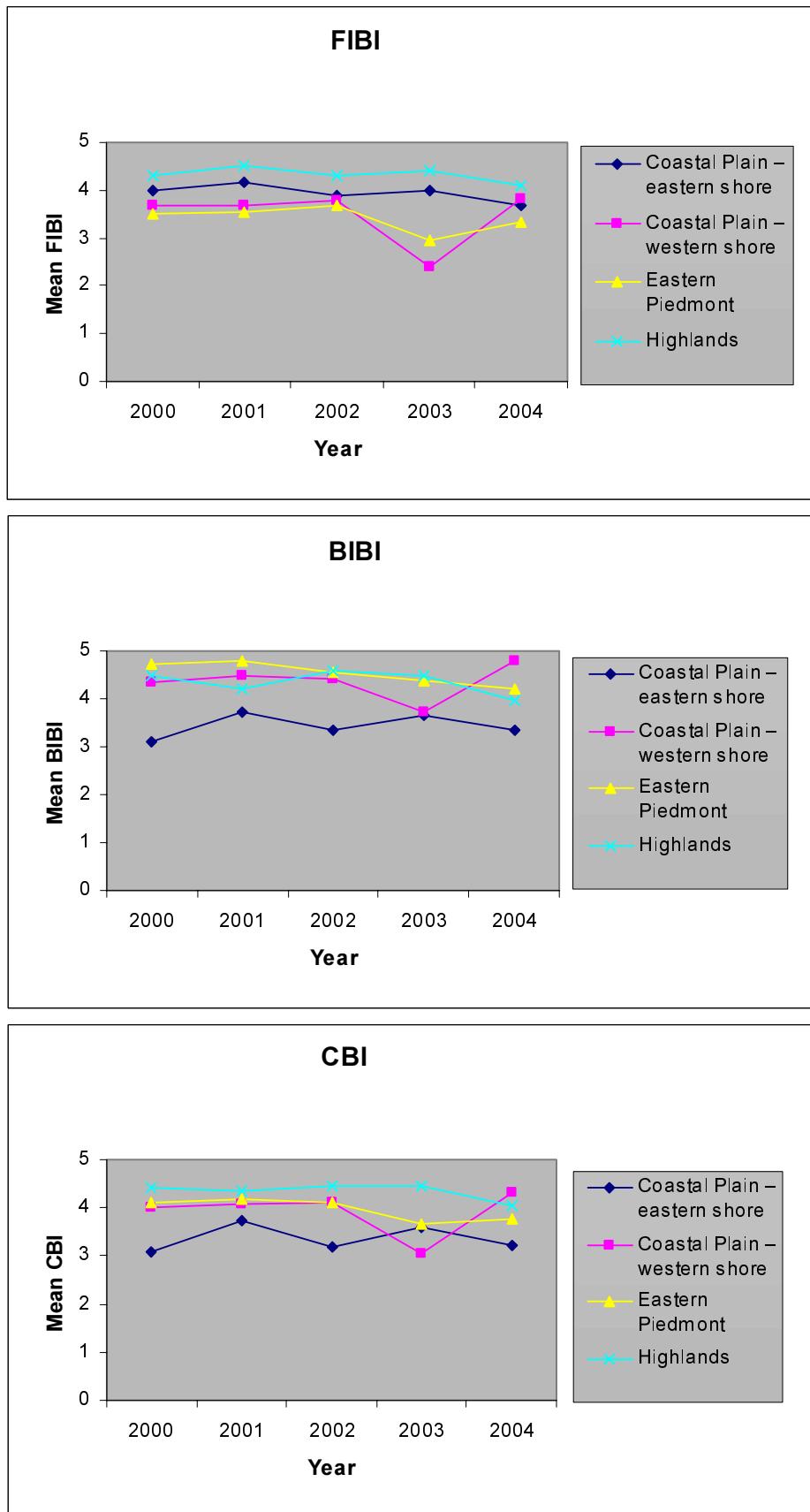


Figure 11-10. Mean annual FIBI, BIBI, and CBI for sentinel sites by region.

Appendix A
Sentinel Sites in the Coastal Plain – Eastern Shore Region

Unnamed Tributary to Emory Creek (CORS-102-S)

Leonard Pond Run (WIRH-220-S)

Millville Creek (NASS-108-S)

Nassawango Creek (NASS-302-S)

Unnamed Tributary to Skeleton Creek (UPCK-113-S)

Swan Creek (LOCR-102-S)

Unnamed Tributary to Emory Creek (CORS-102-S)

Site CORS-102-S is located on an unnamed tributary to Emory Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Corsica River Watershed in Queen Anne's County. This site was sampled in 2000 to 2004. Its watershed is primarily forested (90%), with 10% agriculture.



Unnamed tributary to Emory Creek in spring 2004.

Water Chemistry

Summer water chemistry data collected at the unnamed tributary to Emory Creek (2000 to 2004).

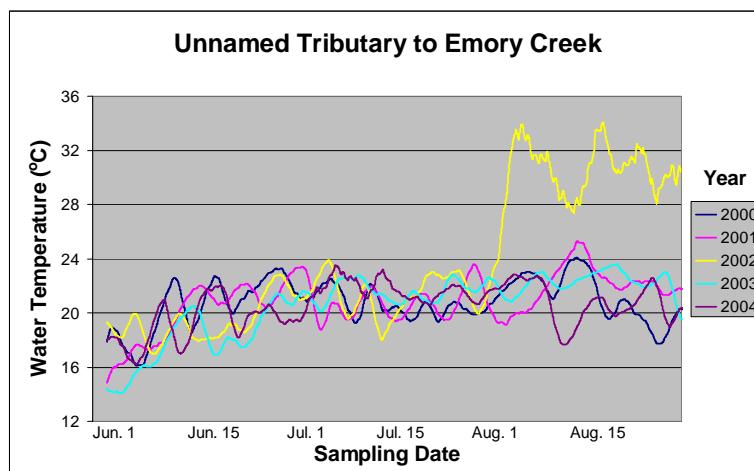
Parameter	2000	2001	2002	2003	2004
Field pH	6.4	7.2		5.8	6.8
Dissolved Oxygen (mg/L)	5.9	5.2	Not sampled in summer (dry)	7.3	5.7
Conductivity (mS)	0.09	0.13		0.053	0.13
Turbidity (NTU)	11	10.7		9.6	13.9

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to Emory Creek (2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	2000	2001	2002	2003	2004
Instream habitat (0-20)	10	8		14	8
Epifaunal substrate (0-20)	8	9		12	9
Velocity/Depth Diversity (0-20)	8	9	Not sampled in summer (dry)	16	8
Pool Quality (0-20)	9	13		16	11
Riffle Quality (0-20)	12	8		16	6
Shading (%)	80	92		95	93
Embeddedness (%)	40	60		20	20
Discharge (cfs)	.58	.02		4.13	.02

The graph below displays temperature logger data for the unnamed tributary to Emory Creek during 2000 to 2004. In 2002, the tributary became dewatered during summer drought conditions.



The graph illustrates how the temperature logger recorded air temperatures rather than water temperatures during August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Emory Creek by sampling year.

Parameter	2000	2001	2002	2003	2004
American eel	3	0		1	0
Eastern mudminnow	37	168	Not sampled in summer (dry)	23	33
Golden shiner	0	0		1	0
Redfin pickerel	6	5		3	8

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna collected in or near the unnamed tributary to Emory Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Fowler's Toad, Gray Treefrog, Northern Green Frog, Northern Spring Peeper, Southern Leopard Frog, Wood Frog

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Emory Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Annelida	Enchytraeidae	Worm	*(0.9)	0(0)	0(0)	*(1.6)	0(0)
		Naididae	Worm	*(7.7)	0(0)	0(0)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	*(0.9)	0(0)	0(0)	*(1.0)
		Tubificida	Worm	*(3.4)	*(0.9)	*(5.1)	*(1.6)	0(0)
	Amphipoda	Crangonyctidae	Scud	*(10.3)	1(0.9)	0(0)	1(2.3)	1(16.4)
		Gammaridae	Scud	0(0)	1(1.8)	0(0)	1(0.8)	0(0)
	Coleoptera	Dytiscidae	Beetle	*(1.7)	0(0)	0(0)	1(0.8)	0(0)
		Elmidae	Beetle	0(0)	0(0)	1(0.9)	0(0)	0(0)
	Diptera	Hydrophilidae	Beetle	0(0)	0(0)	0(0)	0(0)	1(1.0)
		Scirtidae	Beetle	0(0)	*(0.9)	0(0)	*(0.8)	0(0)
Mollusca	Ephemeroptera	Ceratopogonidae	True Fly	0(0)	0(0)	*(0.9)	0(0)	0(0)
		Chironomidae	True Fly	11(46.2)	12(34.9)	5(78.8)	5(12.5)	6(21.2)
	Isopoda	Simuliidae	True Fly	3(10.3)	2(45.0)	1(0.9)	2(59.4)	2(7.7)
		Tabanidae	True Fly	0(0)	1(0.9)	1(0.9)	0(0)	0(0)
	Odonata	Tipulidae	True Fly	0(0)	1(0.9)	0(0)	0(0)	1(1.0)
		Ameletidae	Mayfly	1(2.6)	0(0)	0(0)	0(0)	0(0)
	Plecoptera	Baetidae	Mayfly	0(0)	0(0)	0(0)	0(0)	1(1.06)
		Leptophlebiidae	Mayfly	1(0.9)	1(1.8)	0(0)	1(1.6)	1(4.8)
	Trichoptera	Asellidae	Aquatic Sow Bug	1(5.1)	0(0)	0(0)	1(0.8)	1(1.9)
		Cordulegastridae	Dragonfly/ Damselfly	0(0)	0(0)	1(0.9)	0(0)	0(0)
	Veneroida	Nemouridae	Stonefly	1(5.1)	1(1.8)	0(0)	2(16.4)	1(37.5)
		Perlodidae	Stonefly	*(0.9)	0(0)	0(0)	0(0)	0(0)
Basommatophora	Trichoptera	Hydropsychidae	Caddisfly	0(0)	1(1.8)	0(0)	0(0)	0(0)
		Limnephilidae	Caddisfly	2(2.6)	0(0)	*(0.9)	0(0)	*(6.7)
	Physidae	Philopotamidae	Caddisfly	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Planorbidae	Snail	1(1.7)	1(3.7)	1(2.5)	0(0)	0(0)
	Sphaeriidae	Bivalve	Snail	0(0)	1(0.9)	1(5.9)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Leonard Pond Run (WIRH-220-S)

Site WIRH-220-S is located on Leonard Pond Run in the Coastal Plain – eastern shore region of Maryland. It is in the Wicomico River head Watershed in Wicomico County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (51%), with 41% agriculture and 7% urban.



Leonard Pond Run in spring 2004.



Water Chemistry

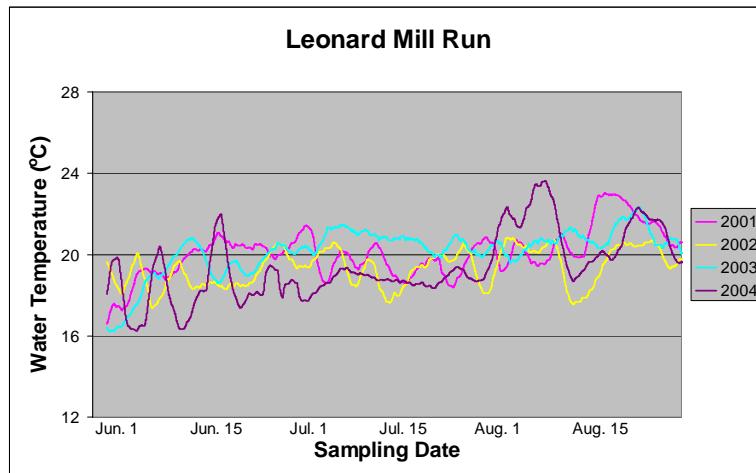
Summer water chemistry data collected at Leonard Pond Run (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.6	5.9	6.5	6.5	5.9	6.2
Dissolved Oxygen (mg/L)	6.7	7.5	7.3	9	6.7	7.6
Conductivity (mS)	.11	0.14	0.13	0.14	0.12	0.13
Turbidity (NTU)	Not measured	1.8	2.9	2.3	7.1	3.1

Physical Habitat

Physical habitat measurements collected at Leonard Pond Run (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	16	19	18	17	16	15
Epifaunal substrate (0-20)	10	16	16	13	16	13
Velocity/Depth Diversity (0-20)	17	18	19	15	17	13
Pool Quality (0-20)	14	17	17	17	16	16
Riffle Quality (0-20)	16	15	0	13	16	16
Shading (%)	60	87	85	60	80	78
Embeddedness (%)	100	100	100	100	100	100
Discharge (cfs)	9.07	39.23	20.77	13.82	31.74	18.07



The above graph displays the temperature logger data for Leonard Pond Run for 2001 to 2004. Maximum recorded temperatures occurred during August 2004.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Leonard Pond Run by year.

Parameter	1995	2000	2001	2002	2003	2004
American eel	9	5	7	15	3	10
Black crappie	0	1	3	0	0	0
Bluegill	12	27	37	9	31	32
Brown bullhead	2	0	0	2	0	1
Chain pickerel	7	26	26	17	11	16
Creek chubsucker	0	12	6	1	0	2
Eastern Mosquitofish	0	0	0	1	0	0
Eastern mudminnow	16	6	6	19	4	9
Golden shiner	0	0	0	0	0	4
Largemouth bass	1	2	6	1	2	8
Least brook lamprey	0	5	2	18	3	19
Margined madtom	2	1	1	4	4	5
Pirate perch	4	7	16	42	10	17
Pumpkinseed	3	1	0	0	17	5
Redfin pickerel	0	0	0	2	0	1
Tadpole madtom	0	1	4	8	1	3
Tessellated darter	19	70	93	220	47	119
White perch	0	2	2	0	2	0
Yellow bullhead	0	1	0	1	0	1
Yellow perch	0	1	0	2	9	8

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Leonard Pond Run.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Fowler's Toad, Green Treefrog, Northern Green Frog, Pickerel Frog, Southern Leopard Frog
Squamata (Snakes and Lizards)	Common Five-linked Skink
Testudines (Turtles)	Eastern Snapping Turtle, Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Leonard Pond Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME (RA)	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Amphipoda	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(1.7)	0(0)
		Lumbriculida	Worm	*(1.0)	0(0)	*(0.9)	0(0)	0(0)	0(0)
		Tubificida	Worm	0(0)	0(0)	*(0.9)	*(1.1)	0(0)	0(0)
Diptera	Coleoptera	Crangonyctidae	Scud	*(14.4)	*(6.1)	0(0)	0(0)	0(0)	0(0)
		Gammaridae	Scud	*(1.0)	0(0)	1(0.9)	0(0)	0(0)	1(3.0)
		Dytiscidae	Beetle	1(6.2)	1(0.9)	1(2.6)	1(3.2)	1(1.7)	1(10.9)
		Elmidae	Beetle	0(0)	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Gyrinidae	Beetle	0(0)	0(0)	0(0)	0(0)	2(3.5)	1(1.0)
	Ephemeroptera	True Fly	True Fly	0(0)	0(0)	0(0)	0(0)	*(1.7)	0(0)
		Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	*(1.1)	0(0)	0(0)
		Chironomidae	True Fly	8(34.0)	9(44.4)	13(44.4)	11(64.2)	14(75.9)	10(54.5)
		Empididae	True Fly	1(1.0)	0(0)	1(0.9)	1(1.1)	0(0)	0(0)
		Ephydriidae	True Fly	0(0)	*(0.9)	0(0)	0(0)	0(0)	0(0)
Isopoda	Ephemeroptera	Sciomyzidae	True Fly	0(0)	0(0)	0(0)	0(0)	*(0.9)	0(0)
		Simuliidae	True Fly	1(15.6)	1(17.4)	*(0.1)	*(1.1)	0(0)	0(0)
		Tabanidae	True Fly	0(0)	0(0)	0(0)	*(1.1)	0(0)	1(1.0)
		Tipulidae	True Fly	0(0)	0(0)	0(0)	0(0)	2(1.7)	0(0)
		Baetidae	Mayfly	0(0)	1(2.6)	0(0)	*(1.1)	0(0)	0(0)
	Megaloptera	Ephemerellidae	Mayfly	1(4.1)	1(15.7)	1(24.8)	1(12.6)	1(2.6)	1(1.0)
		Heptageniidae	Mayfly	1(8.3)	1(4.4)	1(10.3)	1(7.4)	*(0.9)	1(8.9)
		Leptophlebiidae	Mayfly	0(0)	*(0.9)	*(0.9)	0(0)	0(0)	0(0)
		Asellidae	Aquatic Sow Bug	1(3.1)	1(1.7)	1(0.9)	0(0)	0(0)	0(0)
Odonata	Odonata	Corydalidae	Alderfly/ Fishfly	0(0)	1(0.9)	0(0)	0(0)	0(0)	0(0)
		Aeshnidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.0)
		Calopterygidae	Dragonfly/	0(0)	0(0)	0(0)	0(0)	1(1.7)	1(1.0)

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Insecta	Plecoptera	Perlidae	Damselfly						
		Perlodidae	Stonefly	*(1.0)	0(0)	0(0)	0(0)	*(1.7)	0(0)
		Taeniopterygidae	Stonefly	0(0)	1(2.6)	1(7.7)	1(4.2)	1(3.5)	1(10.9)
		Hydropsychidae	Caddisfly	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
	Trichoptera	Lepidostomatidae	Caddisfly	0(0)	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Leptoceridae	Caddisfly	0(0)	1(0.9)	0(0)	*(1.1)	0(0)	0(0)
		Limnephilidae	Caddisfly	*(1.0)	0(0)	0(0)	0(0)	*(0.9)	1(1.0)
		Polycentropodidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.0)
		Psychomyiidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.0)
		Physidae	Snail	1(4.1)	0(0)	0(0)	0(0)	0(0)	0(0)
Mollusca	Basommatophora	Sphaeriidae	Bivalve	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.0)
		Sphaeriidae	Bivalve	*(3.1)	0(0)	0(0)	0(0)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Millville Creek (NASS-108-S)

Site NASS-108-S is located on Millville Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Nassawango Creek Watershed in Worcester County. This site was sampled in 1997 and 2000 to 2004. Its watershed is primarily forested (78%), with 13% agriculture, 8% barren, and 1% wetlands.



Millville Creek in spring 2004.



Water Chemistry

Summer water chemistry data collected at Millville Creek (1997 and 2000 to 2004).

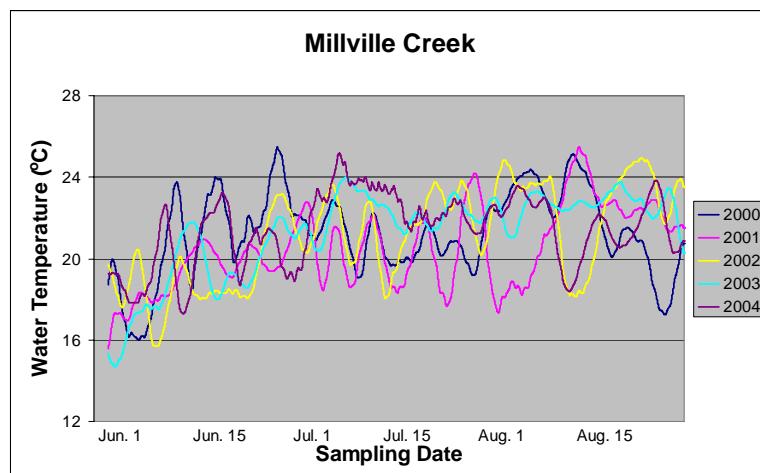
Parameter	1997	2000	2001	2002	2003	2004
Field pH	4.4	4.2	5.1	4.5	4.2	3.9
Dissolved Oxygen (mg/L)	1.5	2.8	1.1	4	1.6	3
Conductivity (mS)	.05	0.08	0.06	0.08	0.07	0.07
Turbidity (NTU)	Not measured	2	24	2.1	2.1	3.4

Physical Habitat

Physical habitat measurements collected at Millville Creek (1997 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1997	2000	2001	2002	2003	2004
Instream habitat (0-20)	17	17	6	12	11	12
Epifaunal substrate (0-20)	16	16	6	7	10	13
Velocity/Depth Diversity (0-20)	2	14	3	7	7	8
Pool Quality (0-20)	18	14	7	11	15	13
Riffle Quality (0-20)	0	0	0	0	0	0
Shading (%)	80	99	93	92	90	90
Embeddedness (%)	100	100	100	100	100	100
Discharge (cfs)	0	.92	0	0	.57	.71

The graph below displays the temperature logger data for Millville Creek for 2000 to 2004.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Millville Creek by sampling year.

Parameter	1997	2000	2001	2002	2003	2004
American eel	0	1	0	0	0	0
Banded sunfish	50	6	0	0	1	10
Bluespotted sunfish	1	0	0	0	0	0
Eastern mudminnow	370	136	1005	181	165	194
Mud sunfish	2	0	1	0	4	0
Pirate perch	18	9	10	5	7	12
Redfin pickerel	38	45	8	16	41	8

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Millville Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Fowler's Toad, Northern Green Frog, Pickerel Frog, Southern Leopard Frog, Wood Frog
Squamata (Snakes and Lizards)	Eastern Fence Lizard
Testudines (Turtles)	Eastern Snapping Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Millville Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1997 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Lumbriculida	Lumbriculidae	Worm	*(4.2)	0(0)	*(1.0)	*(1.8)	*(1.0)	0(0)
	Tubificida	Tubificidae	Worm	*(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
Arthropoda	Amphipoda	Crangonyctidae	Scud	1(2.1)	1(17.9)	2(6.9)	0(0)	1(1.9)	2(34.5)
	Coleoptera	Dytiscidae	Beetle	0(0)	0(0)	0(0)	0(0)	0(0)	1(2.7)
Diptera		Hydrophilidae	Beetle	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Ceratopogonidae	True Fly	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
		Chironomidae	True Fly	5(11.5)	4(26.4)	7(62.8)	4(97.3)	4(50.5)	5(26.6)
		Simuliidae	True Fly	1(17.7)	*(2.8)	2(22.6)	0(0)	1(7.6)	1(0.9)
		Tipulidae	True Fly	0(0)	1(0.94)	0(0)	0(0)	0(0)	0(0)
Isopoda		Asellidae	Aquatic Sow Bug	1(19.8)	1(47.17)	1(1.96)	0(0)	1(1.0)	1(30.1)
Plecoptera		Nemouridae	Stonefly	1(39.6)	1(3.8)	*(2.0)	0(0)	1(36.2)	*(4.4)
Trichoptera		Limnephilidae	Caddisfly	1(2.1)	0(0)	*(2.9)	*(1.0)	1(1.0)	0(0)
		Polycentropodidae	Caddisfly	0(0)	1(0.9)	0(0)	0(0)	1(1.0)	0(0)
Platyhelminthes	Tricladida	Planariidae	Flatworm	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Nassawango Creek (NASS-302-S)

Site NASS-302-S is located on Nassawango Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Nassawango Creek Watershed in Worcester County. This site was sampled in 2001 to 2004. Its watershed is primarily forested (72%), with 24% agriculture, 3% barren, and 1% urban.



Nassawango Creek in spring 2004.

Water Chemistry

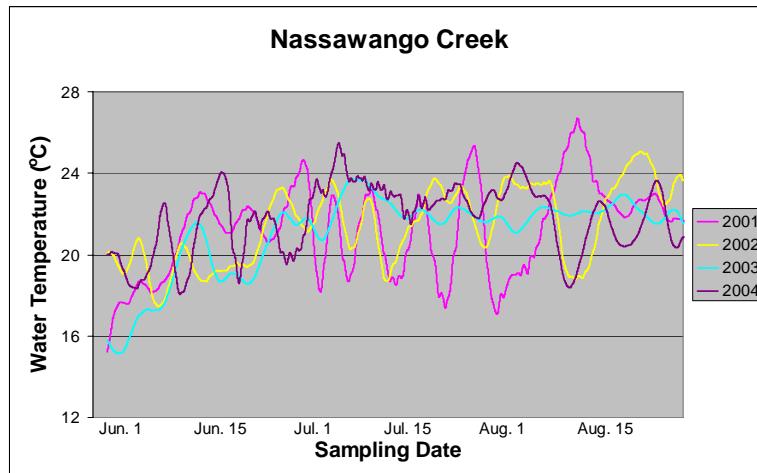
Summer water chemistry data collected at Nassawango Creek (2001 to 2004).

Parameter	2001	2002	2003	2004
Field pH	6.4	6.5	5.2	
Dissolved Oxygen (mg/L)	5.1	5.7	3.9	
Conductivity (mS)	0.09	0.08	0.07	Not sampled (high flow conditions)
Turbidity (NTU)	8.5	16.8	12.5	

Physical Habitat

Physical habitat measurements collected at Nassawango Creek (2001 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	2001	2002	2003	2004
Instream habitat (0-20)	19	16	16	
Epifaunal substrate (0-20)	18	14	13	
Velocity/Depth Diversity (0-20)	8	10	8	
Pool Quality (0-20)	19	17	17	Not sampled (high flow conditions)
Riffle Quality (0-20)	0	0	0	
Shading (%)	80	89	85	
Embeddedness (%)	100	100	100	
Discharge (cfs)	8.91	.87	12.88	



The graph above displays the temperature logger data for Nassawango Creek for 2001 to 2004. Maximum recorded temperatures occurred during August 2001.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Nassawango Creek by sampling year. Fish were not sampled during 2004 due to high flow conditions.

Parameter	2001	2002	2003	2004
American eel	31	58	52	
Banded sunfish	11	7	35	
Black crappie	0	0	1	
Bluegill	1	8	3	
Bluespotted sunfish	17	12	4	
Brown bullhead	0	2	1	
Chain pickerel	17	6	10	
Creek chubsucker	16	18	35	
Eastern mudminnow	25	60	9	
Golden shiner	117	88	96	
Largemouth bass	0	0	1	Not sampled (high flow conditions)
Least brook lamprey	0	1	5	
Margined madtom	0	1	1	
Pirate perch	35	68	35	
Pumpkinseed	7	14	9	
Redbreast sunfish	1	1	6	
Redfin pickerel	17	12	34	
Tadpole madtom	7	9	0	
Tessellated darter	1	4	0	
Yellow bullhead	1	1	0	
Yellow perch	15	33	7	

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Nassawango Creek.

Order (Common)	Species
Anura (Frogs and Toads)	Eastern Snapping Turtle, Northern Green Frog, Pickerel Frog
Testudines (Turtles)	Stinkpot

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Nassawango Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaxida	Enchytraeidae	Worm	0(3.8)*	0(0)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(12.3)*	0(0)	0(0)	0(0)
	Tubificida	Tubificidae	Worm	0(7.6)*	0(0)	0(0.8)*	0(0)
Arthropoda	Amphipoda	Crangonyctidae	Scud	1(6.6)	1(1.0)	0(0)	2(6.0)
	Coleoptera	Dytiscidae	Beetle	0(0)	1(1.0)	0(0)	1(6.0)
		Elmidae	Beetle	0(0)	1(3.8)	0(0)	0(0)
	Decapoda	Palaemonidae	Shrimp	0(0)	0(0)	0(0)	1(1.2)
Diptera	Ceratopogonidae	True Fly	0(0)	0(0)	*(0.8)	0(0)	
		Chironomidae	True Fly	3(3.8)	11(50.5)	8(39.3)	8(28.6)
		Simuliidae	True Fly	0(0)	0(0)	1(28.7)	0(0)
	Tipulidae	True Fly	0(0)	0(0)	0(0)	*(1.2)	
Ephemeroptera	Ephemerellidae	Mayfly	1(3.8)	1(6.7)	1(0.8)	0(0)	
		Heptageniidae	Mayfly	0(0)	0(0)	1(4.1)	0(0)
		Leptophlebiidae	Mayfly	1(47.2)	*(29.5)	1(14.8)	1(38.1)
Isopoda	Asellidae	Aquatic Sow Bug	1(8.5)	1(1.0)	1(4.9)	1(4.8)	
Odonata	Aeshnidae	Dragonfly/Damsel Fly	0(0)	1(1.0)	0(0)	1(1.2)	
	Coenagrionidae	Dragonfly/Damsel Fly	0(0)	*(1.9)	0(0)	0(0)	
		Taeniopterygidae	Stonefly	0(0)	0(0)	0(0)	1(4.8)
Plecoptera	Hydropsychidae	Caddisfly	0(0)	0(0)	1(0.8)	0(0)	
		Leptoperidae	Caddisfly	0(0)	2(1.9)	0(0)	0(0)
		Limnephilidae	Caddisfly	1(5.7)	*(1.0)	2(4.1)	2(3.6)
		Phryganeidae	Caddisfly	1(0.9)	0(0)	0(0)	0(0)
Mollusca	Polycentropodidae	Caddisfly	0(0)	1(1.0)	0(0)	0(0)	
		Sphaeriidae	Bivalve	0(0)	0(0)	0(0)	1(4.8)
		Planariidae	Flatworm	0(0)	0(0)	1(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Unnamed Tributary to Skeleton Creek (UPCK-113-S)

Site UPCK-113-S is located on an unnamed tributary to Skeleton Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Upper Choptank River Watershed in Caroline County. This site was sampled in 1996 and 2000 to 2004. Its watershed is primarily forested (61%), with 5% wetland and 34% agriculture.



Skeleton Creek in the spring 2004



Water Chemistry

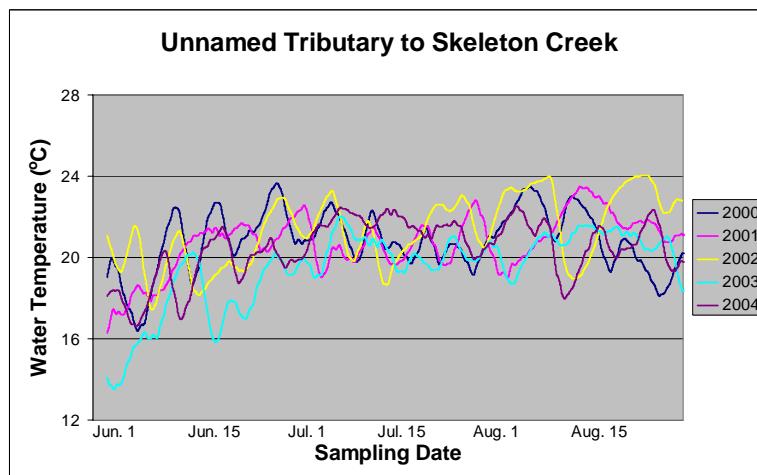
Summer water chemistry data collected at the unnamed tributary to Skeleton Creek (1996 and 2000 to 2004).

Parameter	1996	2000	2001	2002	2003	2004
Field pH	6.8	5.7	6.8	6.9	6.6	6.8
Dissolved Oxygen (mg/L)	7.3	5.2	3.9	3.2	5.2	3.3
Conductivity (mS)	0.17	0.07	0.18	0.19	0.18	0.19
Turbidity (NTU)	Not measured	9.5	8.6	4.9	11.7	24.9

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to Skeleton Creek (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	12	17	11	13	11	12
Epifaunal substrate (0-20)	10	17	9	13	11	11
Velocity/Depth Diversity (0-20)	4	14	10	8	13	10
Pool Quality (0-20)	8	14	12	12	14	13
Riffle Quality (0-20)	2	7	8	7	8	9
Shading (%)	80	96	97	96	95	95
Embeddedness (%)	85	40	40	15	50	65
Discharge (cfs)	.13	1.00	.04	.02	.04	.04



The above graph displays the temperature logger data for the unnamed tributary to Skeleton Creek for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Skeleton Creek by sampling year.

Species	1996	2000	2001	2002	2003	2004
American eel	10	13	11	8	4	6
Bluegill	0	4	0	0	5	2
Brown bullhead	0	0	0	0	3	7
Creek chubsucker	2	0	1	2	0	9
Eastern mudminnow	51	25	30	55	95	53
Golden shiner	0	0	0	0	3	2
Pirate perch	34	95	39	6	8	10
Pumpkinseed	5	0	0	0	1	3
Redfin pickerel	7	0	2	25	11	52

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Skeleton Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern Spadefoot, Fowler's Toad, Northern Green Frog, Northern Spring Peeper, Pickerel Frog, Southern Leopard Frog
Squamata (Snakes)	Northern Black Racer, Northern Watersnake
Testudines (Turtles)	Eastern Snapping Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Skeleton Creek by sampling year, (genera (RA)) = (number of genera (relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.9)	0(0)
	Lumbriculida	Lumbriculidae	Worm	*(0.9)	0(0)	0(0)	0(0)	*(3.7)	0(0)
Annelida	Tubificida	Tubificidae	Worm	*(0.9)	*(2.5)	0(0)	0(0)	*(3.7)	0(0)
	Arthropoda	Amphipoda	Crangonyctidae	Scud	0(0)	0(0)	0(0)	0(0)	2(2.7)
		Gammaridae	Scud	0(0)	1(2.5)	1(1.6)	0(0)	1(16.5)	1(4.5)
Coleoptera	Dytiscidae	Dytiscidae	Beetle	0(0)	0(0)	*(0.8)	1(0.8)	1(3.7)	0(0)
	Elmidae	Elmidae	Beetle	1(0.9)	2(7.6)	1(4.1)	1(0.8)	2(3.7)	0(0)
Decapoda	Ptilodactylidae	Ptilodactylidae	Beetle	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Cambaridae	Cambaridae	Crayfish	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
Diptera	Chironomidae	Chironomidae	True Fly	10(51.8)	6(21.0)	6(59.8)	5(46.3)	11(27.5)	5(14.4)
	Simuliidae	Simuliidae	True Fly	2(36.4)	3(48.7)	4(12.3)	2(33.1)	2(10.1)	3(60.4)
Ephemeroptera	Tipulidae	Tipulidae	True Fly	0(0)	1(1.7)	0(0)	0(0)	0(0)	1(0.9)
	Hemiptera	Caenidae	Mayfly	1(0.9)	0(0)	0(0)	0(0)	0(0)	0(0)
		Leptophlebiidae	Mayfly	*(0.9)	0(0)	2(4.1)	1(11.6)	1(4.6)	*(0.9)
Isopoda	Belostomatidae	Belostomatidae	True Bug	0(0)	0(0)	0(0)	1(0.83)	0(0)	0(0)
	Corixidae	Corixidae	True Bug	0(0)	0(0)	*(0.8)	0(0)	0(0)	0(0)
Megaloptera	Nepidae	Nepidae	True Bug	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
	Asellidae	Asellidae	Aquatic Sow Bug	0(0)	0(0)	1(4.1)	1(4.1)	1(16.5)	1(5.4)
Odonata	Corydalidae	Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)
	Calopterygidae	Calopterygidae	Dragonfly/ Damselfly	0(0)	0(0)	1(0.8)	0(0)	1(0.92)	0(0)
Plecoptera	Coenagrionidae	Coenagrionidae	Dragonfly/ Damselfly	0(0)	0(0)	*(0.8)	0(0)	0(0)	0(0)
	Capniidae	Capniidae	Stonefly	0(0)	1(0.8)	0(0)	*(0.8)	0(0)	*(0.9)
Trichoptera	Nemouridae	Nemouridae	Stonefly	1(5.5)	1(5.8)	*(1.6)	0(0)	0(0)	*(1.8)
	Hydropsychidae	Hydropsychidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
Mollusca	Limnephilidae	Limnephilidae	Caddisfly	0(0)	1(2.5)	1(0.8)	0(0)	0(0)	1(1.8)
	Phryganeidae	Phryganeidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
Basommatophora	Psychomyiidae	Psychomyiidae	Caddisfly	0(0)	0(0)	1(1.6)	0(0)	0(0)	1(1.8)
	Physidae	Physidae	Snail	0(0)	0(0)	1(1.6)	0(0)	0(0)	0(0)
	Planorbidae	Planorbidae	Snail	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)

<i>PHYLUM</i>	<i>ORDER</i>	<i>FAMILY</i>	<i>COMMON NAME</i>	1996 <i>genera</i> (RA)	2000 <i>genera</i> (RA)	2001 <i>genera</i> (RA)	2002 <i>genera</i> (RA)	2003 <i>genera</i> (RA)	2004 <i>genera</i> (RA)
Nematomorpha	Mesogastropoda	Hydrobiidae	Snail	0(0)	*(0.8)	0(0)	0(0)	0(0)	0(0)
		Viviparidae	Snail	1(0.9)	1(0.8)	0(0)	0(0)	0(0)	1(0.9)
	Veneroida	Sphaeriidae	Bivalve	1(0.9)	1(3.4)	1(3.3)	1(0.8)	*(2.8)	*(0.9)
	Gordioidea	Gordiidae	Worm	0(0)	*(0.8)	0(0)	0(0)	0(0)	0(0)
Platyhelminthes	Tricladida	Planariidae	Flatworm	0(0)	0(0)	1(0.8)	0(0)	1(4.6)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Swan Creek (LOCR-102-S)

Site LOCR-102-S is located on Swan Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Lower Chester River Watershed in Kent County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (85%), with 10% agriculture and 5% wetlands.



Swan Creek in spring 2004.



Water Chemistry

Summer water chemistry data collected at Swan Creek (1995 and 2000 to 2004)

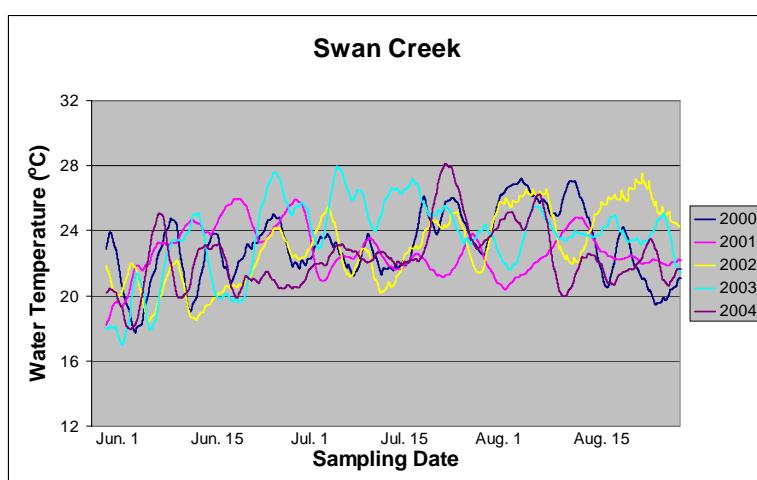
Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.3	7.0	6.7	4.7	5.9	6.0
Dissolved Oxygen (mg/L)	0.8	5	2.9	6.91	4.1	5.9
Conductivity (mS)	.19	0.11	0.09	0.12	0.06	0.09
Turbidity (NTU)	Not measured	11.8	27	73	17.9	36.8

Physical Habitat

Physical habitat measurements collected at Swan Creek (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	15	16	8	11	13	13
Epifaunal substrate (0-20)	5	17	8	11	14	11
Velocity/Depth Diversity (0-20)	3	8	4	5	12	9
Pool Quality (0-20)	14	11	7	5	13	12
Riffle Quality (0-20)	0	10	8	0	11	11
Shading (%)	80	40	20	65	65	40
Embeddedness (%)	100	30	99	100	30	100
Discharge (cfs)	0	.29	.05	0	.22	.21

The graph below displays the temperature logger data for Swan Creek for 2000 to 2004. Maximum recorded temperatures occurred during July 2004.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Swan Creek by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
American eel	1	9	6	10	4	6
Black crappie	34	0	0	0	0	1
Bluegill	7	27	0	0	0	9
Brown bullhead	119	0	22	8	2	26
Eastern Mosquitofish	0	0	0	0	1	0
Eastern mudminnow	40	513	1603	515	1768	786
Golden shiner	97	86	97	42	2	39
Largemouth bass	19	0	0	0	0	0
Pumpkinseed	3	528	213	42	21	51
Redfin pickerel	4	0	2	0	7	4
Warmouth	0	16	4	1	0	1
Yellow bullhead	0	1	0	0	0	0
Yellow perch	0	0	0	0	0	1

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Swan Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Fowler's Toad, Green Treefrog, Northern Green Frog, Pickerel Frog, Southern Leopard Frog
Squamata (Snakes and Lizards)	Eastern Rat Snake, Northern Watersnake, Ringneck Snake
Testudines (Turtles)	Eastern Painted Turtle, Eastern Snapping Turtle, Red Bellied Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the Swan Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME (RA)	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	*(0.9)	*(1.0)	0(0)	0(0)
		Naididae	Worm	0(0)	0(0)	0(0)	*(2.0)	*(0.8)	0(0)
	Lumbriculida	Lumbriculidae	Worm	*(1.0)	*(10.4)	*(5.9)	*(4.0)	*(1.6)	0(0)
	Tubificida	Tubificidae	Worm	0(0)	*(5.7)	*(1.7)	*(4.0)	*(0.8)	0(0)
	Amphipoda		Scud	0(0)	*(1.9)	0(0)	0(0)	0(0)	0(0)
	Coleoptera	Crangonyctidae	Scud	1(4.1)	0(0)	0(0)	0(0)	1(1.6)	1(0.7)
		Dytiscidae	Beetle	1(2.0)	0(0)	0(0)	0(0)	1(0.8)	0(0)
		Haliphilidae	Beetle	0(0)	0(0)	0(0)	1(3.0)	0(0)	0(0)
		Scirtidae	Beetle	*(2.0)	0(0)	0(0)	0(0)	0(0)	0(0)
	Diptera		True Fly	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)
Mollusca		Ceratopogonidae	True Fly	1(1.02)	1(1.9)	0(0)	0(0)	0(0)	0(0)
		Chironomidae	True Fly	10(51.0)	9(17.0)	9(26.3)	11(62.6)	8(63.5)	8(30.7)
		Simuliidae	True Fly	0(0)	1(2.8)	3(53.4)	0(0)	3(23.0)	2(62.8)
		Tabanidae	True Fly	1(1.0)	1(1.9)	0(0)	*(1.0)	0(0)	0(0)
		Tipulidae	True Fly	0(0)	0(0)	1(0.9)	1(1.0)	*(0.8)	1(1.5)
	Ephemeroptera	Caenidae	Mayfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)
	Hemiptera	Corixidae	True Bug	*(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
	Isopoda	Asellidae	Aquatic	1(6.1)	1(36.8)	1(4.2)	1(2.0)	1(3.2)	1(2.9)
	Lepidoptera	Tortricidae	Aquatic Moth	*(3.1)	0(0)	0(0)	0(0)	0(0)	0(0)
	Odonata	Coenagrionidae	Dragonfly/Damselfly	0(0)	0(0)	*(0.9)	0(0)	0(0)	0(0)
Bivalvia	Plecoptera	Nemouridae	Stonefly	1(3.1)	0(0)	*(1.7)	0(0)	1(1.6)	0(0)
	Trichoptera	Hydropsychidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.7)
		Limnephilidae	Caddisfly	0(0)	0(0)	0(0)	*(3.0)	0(0)	1(0.7)
	Basommatophora	Lymnaeidae	Snail	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
		Physidae	Snail	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
Veneroida		Planorbidae	Snail	1(4.1)	0(0)	1(0.9)	1(3.0)	0(0)	0(0)
		Sphaeriidae	Bivalve	0(0)	0(0)	0(0)	1(12.1)	0(0)	0(0)
		Sphaeriidae	Bivalve	1(18.4)	1(21.7)	1(3.4)	0(0)	1(1.6)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Appendix B
Sentinel Sites in the Coastal Plain – Western Shore Region

Hoghole Run (PTOB-002-S)
Mattawoman Creek (MATT-033)
Mill Run (Nanjemoy Creek, NANJ-331-S)
Unnamed Tributary to St. Clements Creek (STCL-051-S)
Swanson Creek (PAXL-294-S)
Unnamed Tributary to Zekiah Swamp Run (ZEKI-012-S)

Hoghole Run (PTOB-002-S)

Site PTOB-002-S is located on Hoghole Run in the Coastal Plain – western shore region of Maryland. It is in the Port Tobacco River Watershed in Charles County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (84%), with 13% agriculture and 4% urban.



Hoghole Run in spring 2004.

Water Chemistry

Summer water chemistry data collected at Hoghole Run (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.3	6.8	7.2	6.0	6.2	6.0
Dissolved Oxygen (mg/L)	7.4	5.7	7.7	1.2*	8.7	7.3
Conductivity (mS)	0.07	0.05	0.05	0.07	0.06	0.05
Turbidity (NTU)	Not measured	4.3	9.7	1.2	5.5	9.1

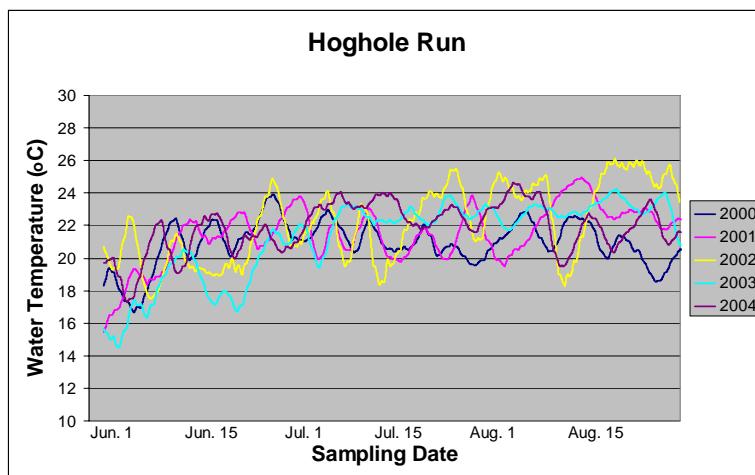
* Dissolved oxygen measured in a standing pool during extreme drought conditions.

Physical Habitat

Physical habitat measurements collected at Hoghole Run (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	15	17	18	10	13	16
Epifaunal substrate (0-20)	16	15	18	9	17	15
Velocity/Depth Diversity (0-20)	16	14	14	2	12	13
Pool Quality (0-20)	15	16	15	9	14	14
Riffle Quality (0-20)	16	12	14	0	15	14
Shading (%)	75	80	90	96	93	85
Embeddedness (%)	15	40	15	21	35	40
Discharge (cfs)	1.41	.38	.36	0	3.89	.28

The graph below displays the temperature logger data for Hoghole Run for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Hoghole Run by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
American eel	61	2	4	0	2	0
Bluegill	13	2	0	0	0	0
Creek chub	31	71	60	121	1	78
Creek chubsucker	48	3	3	4	0	3
Eastern blacknose dace	31	58	101	13	17	175
Eastern mudminnow	69	61	11	142	54	260
Fallfish	8	7	3	3	0	0
Flier	1	0	0	0	0	0
Golden shiner	2	0	0	0	0	0
Least brook lamprey	15	9	10	11	0	1
Pumpkinseed	2	0	0	2	0	0
Rosyside dace	74	82	210	92	0	39
Spottail shiner	2	0	0	0	0	0
Tadpole madtom	0	5	4	1	0	0
Tessellated darter	13	5	19	1	0	0
White sucker	13	27	17	7	0	0

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Hoghole Run.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Fowler's Toad, Northern Green Frog, Northern Spring Peeper, Pickerel Frog
Caudata (Salamanders and Newts)	Northern Two-Lined Salamander
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Hoghole Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Haplotauxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.9)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	*(0.9)	0(0)	*(0.9)	*(0.8)
	Amphipoda	Crangonyctidae	Scud	0(0)	*(6.1)	0(0)	0(0)	0(0)	1(1.7)
	Coleoptera	Elmidae	Beetle	1(3.4)	2(8.1)	1(6.6)	1(1.9)	2(4.6)	0(0)
		Psephenidae	Beetle	0(0)	0(0)	1(1.9)	1(0.9)	0(0)	0(0)
	Collembola			0(0)	0(0)	0(0)	0(0)	*(0.9)	0(0)
	Decapoda	Cambaridae	Crayfish	0(0)	*(1.0)	0(0)	0(0)	0(0)	0(0)
	Diptera	Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	0(0)	2(1.8)	*(0.8)
		Chironomidae	True Fly	10(43.6)	6(13.1)	6(7.6)	6(17.0)	5(7.3)	9(57.9)
		Empididae	True Fly	0(0)	0(0)	0(0)	1(3.8)	0(0)	0(0)
Ephemeroptera		Simuliidae	True Fly	0(0)	1(18.2)	3(60.4)	2(6.6)	2(37.6)	1(3.3)
		Tabanidae	True Fly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
		Tipulidae	True Fly	1(3.4)	3(4.0)	0(0)	1(0.9)	2(1.8)	1(2.5)
		Baetidae	Mayfly	1(38.3)	2(13.1)	1(2.8)	1(22.6)	0(0)	0(0)
		Ephemerellidae	Mayfly	1(0.7)	1(13.1)	1(2.8)	2(8.5)	0(0)	2(1.7)
		Heptageniidae	Mayfly	1(2.7)	0(0)	0(0)	1(7.6)	0(0)	0(0)
		Leptophlebiidae	Mayfly	0(0)	0(0)	0(0)	*(0.9)	0(0)	0(0)
	Isopoda	Asellidae	Aquatic Sow Bug	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
	Odonata	Aeshnidae	Dragonfly/Damselfly	0(0)	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Gomphidae	Dragonfly/Damselfly	0(0)	0(0)	0(0)	*(0.9)	0(0)	0(0)
Plecoptera		Capniidae	Stonefly	1(0.7)	0(0)	0(0)	0(0)	1(6.4)	0(0)
		Chloroperlidae	Stonefly	0(0)	*(4.0)	*(1.9)	*(13.2)	*(0.9)	*(10.7)
		Leuctridae	Stonefly	1(0.7)	1(9.1)	*(0.9)	1(0.9)	*(0.9)	1(9.9)
		Nemouridae	Stonefly	1(2.0)	1(6.1)	1(11.3)	2(8.5)	3(25.7)	0(0)
		Perlidae	Stonefly	1(0.7)	*(1.0)	0(0)	0(0)	0(0)	1(5.0)
		Perlodidae	Stonefly	0(0)	1(2.0)	*(0.9)	2(2.8)	2(3.7)	0(0)
		Taeniopterygidae	Stonefly	0(0)	0(0)	0(0)	1(0.9)	1(5.5)	0(0)
Trichoptera		Hydropsychidae	Caddisfly	2(2.0)	0(0)	1(0.9)	0(0)	0(0)	0(0)

	Limnephilidae	Caddisfly	1(0.7)	0(0)	0(0)	0(0)	0(0)	2(1.7)
	Philopotamidae	Caddisfly	0(0)	1(1.01)	0(0)	0(0)	0(0)	0(0)
	Rhyacophilidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
	Uenoidae	Caddisfly	1(1.3)	0(0)	0(0)	1(0.9)	0(0)	1(1.7)
Nematomorpha	Gordioidea	Gordiidae	Worm	0(0)	0(0)	0(0)	*(0.9)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Mattawoman Creek (MATT-033-S)

Site MATT-033-S is located on Mattawoman Creek in the Coastal Plain – western shore region of Maryland. It is in the Mattawoman Creek Watershed in Charles County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (70%), with 18% agriculture, 9% urban, and 3% barren.



Mattawoman Creek in spring 2004.



Water Chemistry

Summer water chemistry data collected at Mattawoman Creek (1995 and 2000 to 2004).

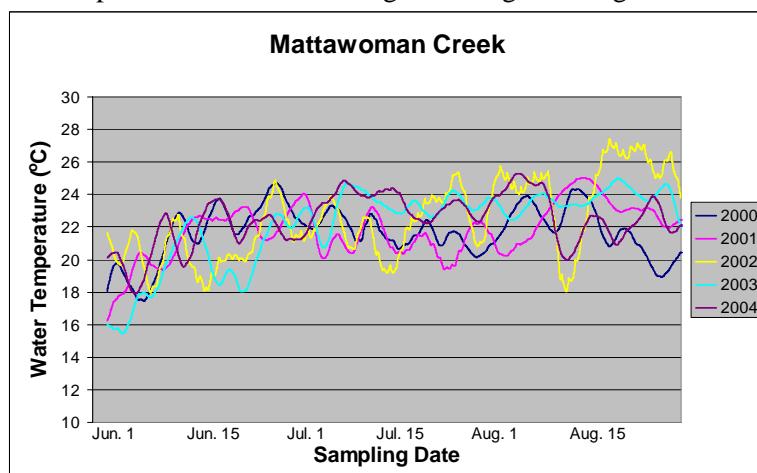
Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.5	6.5	6.8	6.7	6.7	6.3
Dissolved Oxygen (mg/L)	7.1	8.6	0.9	2	6.7	7.4
Conductivity (mS)	0.11	0.08	0.14	0.18	0.11	0.12
Turbidity (NTU)	Not measured	5.6	8.4	15	10.3	8.5

Physical Habitat

Physical habitat measurements collected at Mattawoman Creek (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	15	19	13	13	18	16
Epifaunal substrate (0-20)	14	18	3	11	17	16
Velocity/Depth Diversity (0-20)	17	17	8	6	15	15
Pool Quality (0-20)	15	12	14	12	19	16
Riffle Quality (0-20)	16	13	0	0	14	15
Shading (%)	80	85	90	91	90	85
Embeddedness (%)	40	35	40	35	5	15
Discharge (cfs)	8.28	5.51	0	0	18.89	9.19

The graph below displays the temperature logger data for Mattawoman Creek for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Mattawoman Creek by year.

Parameter	1995	2000	2001	2002	2003	2004
Alewife	0	0	0	0	0	39
American eel	35	26	5	2	20	18
Black crappie	2	0	0	0	0	0
Bluegill	81	25	56	5	31	27
Bluespotted sunfish	0	8	8	0	0	10
Brown bullhead	6	18	3	2	13	36
Chain pickerel	8	3	7	4	6	6
Creek chub	0	1	0	0	0	0
Creek chubsucker	4	0	2	4	0	2
Eastern blacknose dace	3	0	0	0	0	0
Eastern Mosquitofish	0	16	0	1	0	3
Eastern mudminnow	10	20	49	16	67	11
Eastern silvery minnow	2	0	0	0	0	0
Green sunfish	0	1	0	0	2	1
Largemouth bass	0	0	9	0	51	0
Least brook lamprey	2	0	0	0	0	0
Longnose gar	0	0	0	0	1	0
Pirate perch	0	1	0	0	0	0
Pumpkinseed	16	443	49	8	41	58
Redbreast sunfish	1	0	0	0	0	0
Sea lamprey	2	5	5	0	0	2
Spottail shiner	252	2	0	3	84	54
Striped bass	0	0	0	0	0	1
Tadpole madtom	3	5	2	0	1	24
Tessellated darter	59	116	105	15	69	125
Warmouth	2	0	4	0	1	1
White catfish	0	0	0	0	4	0
White sucker	2	2	6	0	0	5
Yellow bullhead	0	1	1	0	1	3

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the Mattawoman Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Fowler's Toad, Eastern Cricket Frog, Northern Green Frog, Northern Spring Peeper, Pickerel Frog, Southern Leopard Frog, Upland Chorus Frog
Caudata (Salamanders and Newts)	Marbled Salamander, Northern Two-Lined Salamander
Squamata (Snakes and Lizards)	Common Five-linked Skink, Eastern Gartersnake, Eastern Rat Snake, Hog-Nosed Snake, Northern Black Racer
Testudines (Turtles)	Eastern Box Turtle, Eastern Painted Turtle, Eastern Snapping Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Mattawoman Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME (RA)	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Annelida	Haplotauxida	Enchytraeidae	Worm 0(0)	*(0.9)	0(0)	*(1.6)	0(0)	0(0)
		Lumbriculida	Lumbriculidae	Worm *(0.8)	*(1.8)	0(0)	*(7.8)	*(0.9)	*(1.6)
		Tubificida	Tubificidae	Worm 0(0)	0(0)	0(0)	1(10.2)	0(0)	0(0)
	Diptera	Amphipoda	Crangonyctidae	Scud 1(0.8)	*(4.4)	0(0)	0(0)	0(0)	0(0)
		Coleoptera	Dryopidae	Beetle 0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)
		Collembola	Elmidae	Beetle 0(0)	1(1.8)	2(10.9)	1(2.3)	1(9.7)	1(7.8)
			Hydrophilidae	Beetle 1(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)
			Isotomidae	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)
			True Fly	0(0)	0(0)	0(0)	*(3.1)	0(0)	0(0)
			Ceratopogonidae	True Fly 0(0)	0(0)	0(0)	1(1.6)	0(0)	0(0)
			Chironomidae	True Fly 2(1.5)	3(5.3)	6(11.8)	7(40.6)	*(1.8)	3(3.1)
			Empididae	True Fly 0(0)	0(0)	1(0.8)	2(1.6)	0(0)	1(2.3)
			Simuliidae	True Fly 1(81.2)	1(10.5)	1(31.9)	1(4.7)	2(64.6)	1(22.5)
			Tabanidae	True Fly 0(0)	0(0)	0(0)	1(1.6)	0(0)	0(0)

PHYLUM	ORDER	FAMILY	COMMON NAME	1995	2000	2001	2002	2003	2004
				genera (RA)					
Ephemeroptera	<i>Tipulidae</i>	True Fly	0(0)	0(0)	1(0.8)	1(1.6)	1(0.9)	0(0)	
		Mayfly	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)	
		Baetidae	Mayfly	0(0)	1(36.8)	*(1.7)	0(0)	0(0)	2(7.8)
		Ephemerellidae	Mayfly	0(0)	2(15.8)	0(0)	1(0.8)	0(0)	1(12.4)
	Heptageniidae	Mayfly	0(0)	0(0)	0(0)	0(0)	0(0)	2(1.6)	
Isopoda	<i>Asellidae</i>	Aquatic Sow Bug	0(0)	1(8.8)	0(0)	1(1.6)	1(1.8)	1(1.6)	
Lepidoptera	Noctuidae	Aquatic Moth	0(0)	0(0)	0(0)	*(0.8)	0(0)	0(0)	
Plecoptera	<i>Capniidae</i>	Stonefly	0(0)	0(0)	1(1.7)	1(0.8)	*(0.9)	0(0)	
	Nemouridae	Stonefly	0(0)	1(7.9)	1(2.5)	0(0)	1(1.8)	0(0)	
	Perlidae	Stonefly	0(0)	1(5.3)	0(0)	1(6.3)	0(0)	1(10.8)	
	Perlodidae	Stonefly	1(0.8)	1(0.9)	1(1.7)	1(4.7)	2(8.0)	1(10.8)	
	Taeniopterygidae	Stonefly	2(10.5)	0(0)	2(10.1)	2(3.9)	3(7.1)	0(0)	
	Glossosomatidae	Caddisfly	1(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)	
	Hydropsychidae	Caddisfly	0(0)	0(0)	2(23.5)	0(0)	0(0)	2(15.5)	
	Leptoceridae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)	
	Limnephilidae	Caddisfly	*(1.5)	0(0)	*(0.8)	1(0.8)	*(2.7)	0(0)	
	Philopotamidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.6)	
Trichoptera	Rhyacophilidae	Caddisfly	1(1.5)	0(0)	0(0)	0(0)	0(0)	0(0)	
	Uenoidae	Caddisfly	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)	
Mollusca	Basommatophora	<i>Planorbidae</i>	Snail	0(0)	0(0)	1(0.8)	0(0)	0(0)	
	Veneroida	<i>Sphaeriidae</i>	Bivalve	0(0)	0(0)	1(0.8)	0(0)	0(0)	
Nemertea	Hoplonemertea	Tetrastemmatidae	Worm	0(0)	0(0)	1(0.8)	0(0)	0(0)	

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Mill Run (Nanjemoy Creek, NANJ-331-S)

Site NANJ-331-S is located on Mill Run in the Coastal Plain – western shore region of Maryland. It is in the Nanjemoy Creek Watershed in Charles County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (81%), with 13% agriculture, 4% urban, and 2% barren.



Mill Run in spring 2004.



Water Chemistry

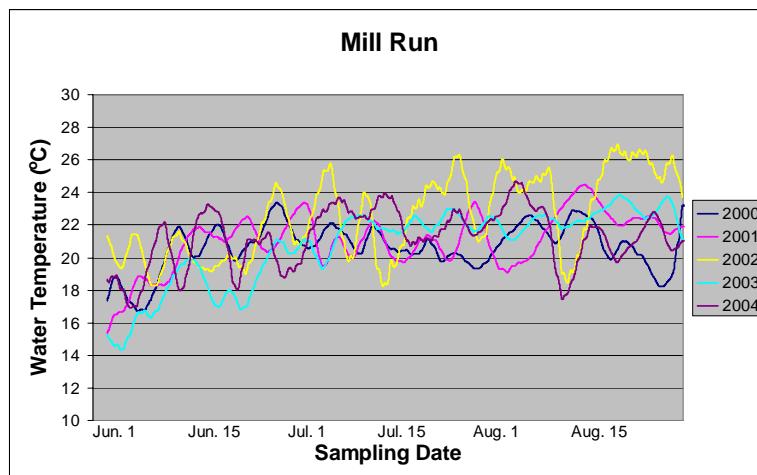
Summer water chemistry data collected at Mill Run (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.9	6.2	6.8	6.3	6.4	6.0
Dissolved Oxygen (mg/L)	6.4	7.2	7.2	0.3	8.6	7.7
Conductivity (mS)	0.06	0.05	0.06	0.14	0.07	0.07
Turbidity (NTU)	Not measured	7.2	8.1	159	4.8	8.8

Physical Habitat

Physical habitat measurements collected at Mill Run (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	12	13	15	7	13	11
Epifaunal substrate (0-20)	5	11	10	7	14	13
Velocity/Depth Diversity (0-20)	14	15	13	2	14	12
Pool Quality (0-20)	13	16	15	6	15	16
Riffle Quality (0-20)	13	7	8	0	12	12
Shading (%)	90	94	95	95	92	85
Embeddedness (%)	80	80	40	100	40	30
Discharge (cfs)	8.84	1.32	.74	0	12.07	1.40



The above graph displays the temperature logger data for Mill Run for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Mill Run by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
American eel	8	4	0	1	0	3
Bluegill	15	3	3	5	3	8
Bluespotted sunfish	0	0	0	3	0	0
Brown bullhead	0	2	2	72	3	4
Chain pickerel	0	1	1	0	1	0
Creek chub	35	3	4	23	0	0
Creek chubsucker	29	3	7	5	0	1
Eastern blacknose dace	14	0	4	0	0	31
Eastern Mosquitofish	0	42	1	55	0	0
Eastern mudminnow	95	2	14	142	9	24
Golden shiner	7	0	0	1	1	31
Largemouth bass	3	7	0	0	0	4
Least brook lamprey	31	0	0	3	0	10
Margined madtom	0	2	0	6	0	0
Pirate perch	0	0	0	1	0	0
Pumpkinseed	10	4	5	2	0	17
Redbreast sunfish	24	1	2	0	0	0
Rosyside dace	42	0	2	4	0	2
Satinfin shiner	0	0	0	0	1	0
Sea lamprey	5	0	0	0	0	30
Spottail shiner	0	0	0	0	5	3
Swallowtail shiner	0	0	0	0	0	1
Tessellated darter	70	24	13	1	0	38
White sucker	51	17	4	9	7	13
Yellow bullhead	0	1	0	3	2	4

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Mill Run.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Eastern Cricket Frog, Northern Green Frog, Northern Spring Peeper, Pickerel Frog, Southern Leopard Frog
Squamata (Snakes and Lizards)	Common Five-linked Skink, Eastern Rat Snake, Northern Ringneck Snake
Testudines (Turtles)	Eastern Snapping Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Mill Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME (RA)	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	0(0)	0(0)	*(1.9)
	Tubificida	Tubificidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)
	Amphipoda	Crangonyctidae	Scud	1(1.0)	*(1.9)	0(0)	1(0.9)	1(0.8)	2(1.9)
	Coleoptera	Elmidae	Beetle	2(10.4)	1(2.8)	3(21.9)	2(18.4)	2(6.3)	0(0)
Diptera	Gyrinidae	Gyrinidae	Beetle	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.9)
	Ceratopogonidae	Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	*(0.9)	0(0)	*(1.9)
	Chironomidae	Chironomidae	True Fly	7(21.9)	1(0.9)	8(21.9)	11(33.3)	2(2.3)	15(34.0)
	Simuliidae	Simuliidae	True Fly	0(0)	1(12.0)	1(5.2)	0(0)	2(10.2)	0(0)
	Tabanidae	Tabanidae	True Fly	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
Ephemeroptera	Tipulidae	Tipulidae	True Fly	0(0)	0(0)	2(3.1)	1(0.9)	0(0)	*(0.9)
	Ameletidae	Ameletidae	Mayfly	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)
	Baetidae	Baetidae	Mayfly	1(33.3)	1(10.2)	1(11.5)	1(26.3)	0(0)	1(11.3)
	Ephemerellidae	Ephemerellidae	Mayfly	2(20.8)	2(68.5)	1(13.5)	2(1.8)	0(0)	2(11.3)
Hemiptera	Heptageniidae	Heptageniidae	Mayfly	0(0)	1(0.9)	*(2.1)	1(5.3)	0(0)	1(8.5)
	Leptophlebiidae	Leptophlebiidae	Mayfly	2(4.2)	0(0)	0(0)	0(0)	0(0)	1(0.9)
	Nepidae	Nepidae	True Bug	0(0)	1(0.9)	0(0)	0(0)	0(0)	0(0)
	Asellidae	Asellidae	Aquatic	0(0)	0(0)	1(1.0)	0(0)	1(0.8)	0(0)
Isopoda	Sow Bug								
	Odonata	Calopterygidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.9)
		Gomphidae	Dragonfly/	0(0)	0(0)	0(0)	*(0.9)	0(0)	0(0)

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
			Damsel&fly						
	Plecoptera	Capniidae	Stonefly	0(0)	0(0)	0(0)	0(0)	*(2.3)	0(0)
		Chloroperlidae	Stonefly	0(0)	0(0)	*(2.1)	*(2.6)	0(0)	*(1.9)
		Leuctridae	Stonefly	0(0)	0(0)	1(1.0)	0(0)	0(0)	0(0)
		Nemouridae	Stonefly	1(5.2)	1(1.9)	*(4.2)	2(3.5)	2(65.6)	1(1.9)
		Perlidae	Stonefly	0(0)	0(0)	1(3.1)	0(0)	0(0)	1(11.3)
		Perlodidae	Stonefly	1(1.0)	0(0)	1(5.2)	0(0)	*(4.7)	1(1.9)
		Taeniopterygidae	Stonefly	0(0)	0(0)	0(0)	1(0.9)	2(3.1)	0(0)
	Trichoptera	Hydropsychidae	Caddisfly	0(0)	0(0)	1(2.1)	1(4.4)	0(0)	1(0.9)
		Limnephilidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	2(4.7)
		Psychomyiidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Uenoidae	Caddisfly	1(1.0)	0(0)	1(2.1)	0(0)	1(1.6)	0(0)
Nematomorpha	Gordioidea	Gordiidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Unnamed Tributary to St. Clements Creek (STCL-051-S)

Site STCL-051-S is located on an unnamed tributary to St. Clements Creek in the Coastal Plain – western shore region of Maryland. It is in the St. Clements Bay Watershed in St. Mary's County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (75%), with 25% agriculture.



Unnamed tributary to St. Clements Creek in spring 2004.

Water Chemistry

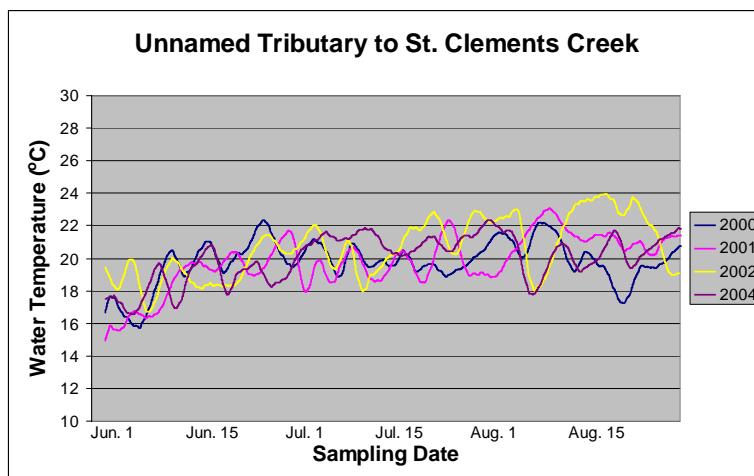
Summer water chemistry data collected at the unnamed tributary to St. Clements Creek (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.3	6.6	7.0	7.0	6.4	6.5
Dissolved Oxygen (mg/L)	7.5	5.7	7.6	4.8	8.6	7.1
Conductivity (mS)	0.09	0.08	0.07	0.09	0.06	0.07
Turbidity (NTU)	Not measured	5	4.1	4.3	2.7	8.8

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to St. Clements Creek (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	12	14	18	14	14	11
Epifaunal substrate (0-20)	11	13	16	15	14	13
Velocity/Depth Diversity (0-20)	12	5	13	8	12	11
Pool Quality (0-20)	11	10	15	7	15	12
Riffle Quality (0-20)	9	6	11	7	14	11
Shading (%)	90	95	95	95	95	92
Embeddedness (%)	5	40	25	30	40	20
Discharge (cfs)	.06	.11	.16	.01	.40	.12



The above graph displays the temperature logger data for the unnamed tributary to St. Clements Creek for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in the unnamed tributary to St. Clements Creek by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
American eel	1	1	0	0	0	0
Creek chubsucker	12	0	2	0	2	2
Eastern blacknose dace	97	26	95	34	13	179
Eastern mudminnow	162	51	80	54	42	73
Fallfish	16	2	8	0	0	0
Least brook lamprey	31	5	2	3	7	20
Pirate perch	9	0	0	0	0	0
Redbreast sunfish	2	0	0	0	0	0
Sea lamprey	1	0	0	0	0	0
Tessellated darter	9	0	3	0	0	1

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the unnamed tributary to St. Clements Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Fowler's Toad, Northern Green Frog, Northern Spring Peeper, Pickerel Frog, Southern Leopard Frog, Wood Frog
Caudata (Salamanders and Newts)	Northern Red Salamander, Northern Two-Lined Salamander
Squamata (Snakes and Lizards)	Northern Black Racer

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to St. Clements Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME (RA)	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaxida	Naididae	Worm	0(0)	*(6.0)	0(0)	0(0)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	*(2.6)	*(0.9)	0(0)	0(0)	*(0.9)
Arthropoda	Amphipoda	Crangonyctidae	Scud	0(0)	*(4.3)	1(1.8)	0(0)	1(6.0)	1(5.7)
	Coleoptera	Gammaridae	Scud	1(17.4)	0(0)	1(0.9)	0(0)	0(0)	1(4.7)
Diptera	Coleoptera	Elmidae	Beetle	1(2.9)	2(10.3)	1(5.3)	1(17.2)	1(7.7)	0(0)
		Gyrinidae	Beetle	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Hydrophilidae	Beetle	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Psephenidae	Beetle	1(4.4)	1(0.9)	0(0)	1(1.6)	1(1.7)	0(0)
		Ptilodactylidae	Beetle	0(0)	1(1.7)	1(1.8)	1(8.2)	0(0)	1(1.9)
	Ephemeroptera	Ceratopogonidae	True Fly	0(0)	1(0.85)	0(0)	0(0)	*(1.71)	1(0.9)
		Chironomidae	True Fly	1(1.5)	6(23.1)	6(19.5)	1(1.6)	2(5.1)	9(39.6)
		Dixidae	True Fly	0(0)	0(0)	0(0)	1(0.82)	0(0)	0(0)
		Simuliidae	True Fly	2(7.3)	1(12.8)	2(31.9)	1(0.8)	2(27.4)	1(2.8)
		Tipulidae	True Fly	1(1.5)	2(2.6)	1(0.9)	2(3.3)	1(7.7)	3(3.8)
Ephemeroptera	Diptera	Baetidae	Mayfly	1(5.8)	1(2.6)	1(8.0)	1(8.2)	0(0)	1(4.7)
		Ephemerellidae	Mayfly	2(23.2)	2(5.1)	1(8.0)	2(34.4)	1(6.0)	2(4.7)
		Heptageniidae	Mayfly	0(0)	0(0)	1(0.9)	1(1.6)	0(0)	1(1.9)
		Leptophlebiidae	Mayfly	1(4.4)	1(14.5)	2(5.3)	1(2.5)	1(1.7)	1(1.9)
		Gerridae	True Bug	1(1.5)	0(0)	0(0)	0(0)	0(0)	0(0)
Hemiptera	Isopoda	Asellidae	Aquatic	1(1.5)	1(2.6)	0(0)	0(0)	1(1.7)	0(0)
	Megaloptera	Corydalidae	Sow Bug	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.9)
Odonata	Megaloptera	Calopterygidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.9)
		Cordulegastridae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	Odonata	Gomphidae	Dragonfly/ Damselfly	1(4.4)	0(0)	0(0)	0(0)	0(0)	0(0)
			Dragonfly/ Damselfly	1(2.9)	*(0.9)	0(0)	*(2.5)	0(0)	0(0)

PHYLUM	ORDER	FAMILY	COMMON NAME	1995	2000	2001	2002	2003	2004
				genera (RA)					
Plecoptera		Capniidae	Stonefly	1(2.9)	0(0)	0(0)	0(0)	1(17.1)	0(0)
		Chloroperlidae	Stonefly	0(0)	*(0.9)	*(5.3)	*(6.6)	*(0.9)	*(1.9)
		Leuctridae	Stonefly	0(0)	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Nemouridae	Stonefly	1(2.9)	1(1.7)	0(0)	1(1.6)	2(9.4)	1(4.7)
		Perlidae	Stonefly	0(0)	0(0)	1(2.7)	*(0.8)	0(0)	1(4.7)
		Perlodidae	Stonefly	1(4.4)	*(5.1)	1(0.9)	0(0)	2(2.6)	*(0.9)
		Brachycentridae	Caddisfly	1(1.5)	0(0)	0(0)	0(0)	0(0)	0(0)
Trichoptera		Hydropsychidae	Caddisfly	1(1.5)	0(0)	1(2.7)	2(7.4)	0(0)	1(1.9)
		Limnephilidae	Caddisfly	0(0)	0(0)	*(1.8)	0(0)	*(1.7)	2(4.7)
		Odontoceridae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Phryganeidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
		Polycentropodidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Psychomyiidae	Caddisfly	1(1.5)	0(0)	0(0)	1(0.8)	0(0)	0(0)
		Rhyacophilidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
		Uenoidae	Caddisfly	1(7.3)	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Planariidae	Flatworm	0(0)	1(1.7)	0(0)	0(0)	0(0)	0(0)
Platyhelminthes	Tricladida								

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Swanson Creek (PAXL-294-S)

Site PAXL-294-S is located on Swanson Creek in the Coastal Plain – western shore region of Maryland. It is in the Lower Patuxent River Watershed in Charles County. This site was sampled in 1997 and 2000 to 2004. Its watershed is primarily forested (70%), with 25% agriculture and 5% urban.



Swanson Creek in spring 2004.



Water Chemistry

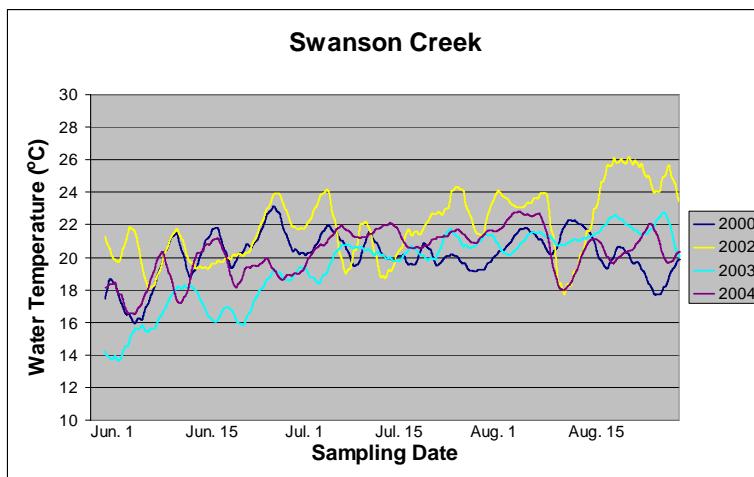
Summer water chemistry data collected at Swanson Creek (1997 and 2000 to 2004).

Parameter	1997	2000	2001	2002	2003	2004
Field pH	8.1	6.7	7.1	6.7	6.9	6.5
Dissolved Oxygen (mg/L)	9.8	7.4	8.2	2.1	8	8
Conductivity (mS)	.08	0.08	0.09	0.1	0.10	0.1
Turbidity (NTU)	Not measured	6.8	6.2	26.1	8.2	6.4

Physical Habitat

Physical habitat measurements collected at Swanson Creek (1997 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1997	2000	2001	2002	2003	2004
Instream habitat (0-20)	14	18	15	6	14	12
Epifaunal substrate (0-20)	13	16	13	4	16	15
Velocity/Depth Diversity (0-20)	14	15	15	6	17	12
Pool Quality (0-20)	14	17	15	11	15	12
Riffle Quality (0-20)	16	14	15	0	16	15
Shading (%)	65	70	92	91	90	90
Embeddedness (%)	20	35	30	50	20	25
Discharge (cfs)	4.21	3.86	7.01	0	14.04	2.62



The above graph displays the temperature logger data for Swanson Creek for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August, 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Swanson Creek by sampling year.

Parameter	1997	2000	2001	2002	2003	2004
American eel	7	5	0	0	1	3
Bluegill	0	1	0	0	0	1
Creek chubsucker	2	2	2	1	1	4
Eastern blacknose dace	103	16	97	62	0	93
Eastern mudminnow	10	21	15	3	2	29
Fallfish	34	3	2	4	0	1
Golden shiner	10	0	2	0	1	0
Largemouth bass	0	0	0	8	0	0
Least brook lamprey	21	0	2	7	0	6
Pumpkinseed	4	3	3	4	1	7
Redbreast sunfish	0	0	0	0	0	1
Redfin pickerel	0	0	1	0	0	0
Rosyside dace	76	40	25	26	17	1
Sea lamprey	4	0	0	26	0	0
Tadpole madtom	9	0	0	0	0	2
Tessellated darter	33	1	30	35	0	16
White sucker	3	1	0	33	0	0

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Swanson Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern Cricket Frog, Northern Green Frog, Northern Spring Peeper, Pickerel Frog, Wood Frog
Caudata (Salamanders and Newts)	Northern Two-lined Salamander
Squamata (Snakes and Lizards)	Eastern Wormsnake, Northern Watersnake
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Swanson Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1997 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(1.8)	0(0)
		Naididae	Worm	0(0)	*(0.7)	0(0)	0(0)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	0(0)	*(2.7)	0(0)
		Crangonyctidae	Scud	0(0)	*(3.5)	0(0)	0(0)	0(0)	0(0)
	Amphipoda	Gammaridae	Scud	0(0)	0(0)	0(0)	0(0)	1(0.9)	1(1.9)
		Dryopidae	Beetle	0(0)	1(0.7)	0(0)	0(0)	0(0)	0(0)
	Coleoptera	Elmidae	Beetle	1(2.0)	1(0.7)	2(10.5)	1(3.2)	0(0)	0(0)
		Ptilodactylidae	Beetle	1(1.0)	1(0.7)	0(0)	0(0)	0(0)	0(0)
	Diptera	Ceratopogonidae	True Fly	1(1.0)	0(0)	0(0)	0(0)	2(1.8)	0(0)
		Chironomidae	True Fly	7(8.2)	1(1.4)	6(7.5)	4(8.9)	4(7.2)	7(41.5)
		Empididae	True Fly	1(1.0)	0(0)	0(0)	1(1.61)	0(0)	1(1.9)
		Simuliidae	True Fly	2(18.4)	1(3.5)	2(2.2)	0(0)	3(3.6)	2(1.9)
		Tabanidae	True Fly	0(0)	0(0)	0(0)	1(0.8)	1(0.9)	0(0)
Ephemeroptera	Diptera	Ptilulidae	True Fly	2(7.1)	1(0.7)	0(0)	2(4.8)	1(1.8)	2(3.8)
		Baetidae	Mayfly	1(18.4)	2(51.0)	1(6.7)	1(12.1)	1(4.5)	1(0.9)
		Ephemerellidae	Mayfly	1(18.4)	2(25.5)	1(57.5)	1(43.6)	1(36.9)	1(14.2)
		Heptageniidae	Mayfly	1(1.0)	1(0.7)	1(2.2)	1(0.8)	0(0)	*(0.9)
		Leptophlebiidae	Mayfly	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)
Isopoda		Asellidae	Aquatic Sow Bug	0(0)	1(2.8)	1(0.8)	0(0)	0(0)	0(0)
		Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
Odonata		Aeshnidae	Dragonfly/ Damselfly	0(0)	0(0)	1(0.8)	1(0.8)	0(0)	0(0)
		Calopterygidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)
		Cordulegastridae	Dragonfly/	0(0)	1(0.7)	0(0)	0(0)	0(0)	0(0)

PHYLUM	ORDER	FAMILY	COMMON NAME	1997	2000	2001	2002	2003	2004
			Damselfly	genera (RA)					
Plecoptera		Chloroperlidae	Stonefly	1(15.3)	*(2.8)	*(5.2)	1(12.9)	*(1.8)	*(12.3)
		Leuctridae	Stonefly	1(2.0)	1(0.7)	0(0)	0(0)	1(0.9)	1(0.9)
		Nemouridae	Stonefly	1(4.1)	1(0.7)	1(0.8)	0(0)	3(6.3)	1(2.8)
		Perlidae	Stonefly	1(1.0)	1(2.1)	*(0.8)	*(0.8)	*(0.9)	1(6.6)
		Perlodidae	Stonefly	1(1.0)	1(0.7)	*(0.8)	1(4.0)	1(20.7)	0(0)
		Taeniopterygidae	Stonefly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
Trichoptera		Hydropsychidae	Caddisfly	0(0)	0(0)	2(3.0)	1(4.0)	0(0)	0(0)
		Limnephilidae	Caddisfly	0(0)	*(0.7)	0(0)	1(0.8)	1(0.9)	*(0.9)
		Phryganeidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
		Uenoidae	Caddisfly	0(0)	0(0)	1(0.8)	1(0.8)	1(3.6)	1(7.6)
Nemertea	Hoplonemertea	Tetrastemmatidae	Worm	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Unnamed Tributary to Zekiah Swamp Run (ZEKI-012-S)

Site ZEKI-012-S is located on an unnamed tributary to Zekiah Swamp Run in the Coastal Plain – western shore region of Maryland. It is in the Zekiah Swamp Watershed in Charles County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (93%), with 7% agriculture.



Unnamed tributary to Zekiah Swamp Run in spring 2004.

Water Chemistry

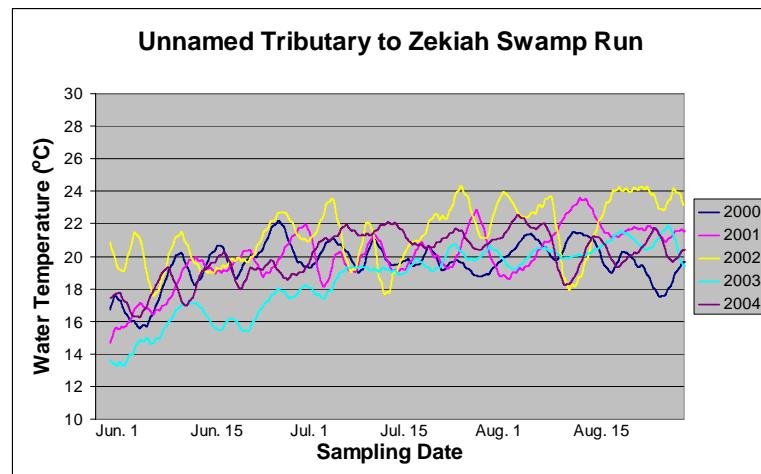
Summer water chemistry data collected at the unnamed tributary to Zekiah Swamp Run (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	6.6	8.1	6.9	6.4	6.2	6.4
Dissolved Oxygen (mg/L)	8.4	5.2	8.2	2.9	8.1	8.3
Conductivity (mS)	0.05	0.05	0.05	0.09	0.06	0.06
Turbidity (NTU)	Not measured	3	3.6	26.1	2.7	4.4

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to Zekiah Swamp Run (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	11	15	17	4	15	13
Epifaunal substrate (0-20)	11	11	17	1	12	14
Velocity/Depth Diversity (0-20)	7	10	10	2	8	11
Pool Quality (0-20)	9	10	10	5	8	7
Riffle Quality (0-20)	11	6	14	0	13	12
Shading (%)	85	95	94	95	94	94
Embeddedness (%)	15	45	16	100	40	15
Discharge (cfs)	.27	.33	.69	0	1.11	.30



The above graph displays the temperature logger data at the unnamed tributary to Zekiah Swamp Run for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August, 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected at the unnamed tributary to Zekiah Swamp Run by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
American eel	4	0	2	0	0	0
Eastern blacknose dace	0	23	21	0	11	20
Eastern mudminnow	99	15	49	57	9	234
Fallfish	0	0	0	2	0	0
Least brook lamprey	37	43	45	21	0	26
Pirate perch	8	0	7	5	0	5
Pumpkinseed	0	0	0	0	0	1
Redfin pickerel	0	10	0	2	0	7
Tessellated darter	0	0	0	2	0	0

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected at or near the unnamed tributary to Zekiah Swamp Run.

Order (Common)	Species
Anura (Frogs and Toads)	Eastern American Toad, Northern Green Frog, Pickerel Frog, Wood Frog
Caudata (Salamanders and Newts)	Northern Red Salamander, Northern Two-Lined Salamander
Squamata (Snakes and Lizards)	Northern Watersnake

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected at the unnamed tributary to Zekiah Swamp Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Haplotaixida	Naididae	Worm	0(0)	*(5.8)	0(0)	0(0)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	*(0.9)	0(0)	*(0.8)
	Coleoptera	Dytiscidae	Beetle	0(0)	1(1.7)	0(0)	0(0)	0(0)	0(0)
		Elmidae	Beetle	2(10.3)	2(40)	2(4.6)	2(25)	3(11.3)	*(0.8)
		Hydrophilidae	Beetle	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Ptilodactylidae	Beetle	1(4.6)	0(0)	0(0)	1(0.9)	0(0)	0(0)
	Diptera	Collembola		0(0)	*(0.8)	0(0)	0(0)	0(0)	0(0)
		Cambaridae	Crayfish	0(0)	0(0)	0(0)	*(0.9)	0(0)	0(0)
		Ceratopogonidae	True Fly	2(2.3)	1(1.7)	1(0.8)	1(5.2)	0(0)	0(0)
		Chironomidae	True Fly	7(16.1)	9(17.5)	5(13.7)	4(3.5)	2(1.7)	7(8.1)
		Dixidae	True Fly	1(2.3)	0(0)	1(0.8)	0(0)	0(0)	0(0)
		Empididae	True Fly	0(0)	0(0)	1(0.8)	0(0)	0(0)	1(0.8)
	Ephemeroptera	Simuliidae	True Fly	2(8.1)	2(3.3)	2(48.1)	3(5.2)	2(76.5)	1(0.8)
		Tipulidae	True Fly	1(4.6)	3(2.5)	0(0)	0(0)	0(0)	1(0.8)
		Baetidae	Mayfly	1(9.2)	1(0.8)	1(6.9)	1(14.7)	0(0)	1(1.6)
		Ephemerellidae	Mayfly	1(12.6)	1(11.7)	1(13.7)	1(15.5)	1(0.9)	1(19.5)
		Heptageniidae	Mayfly	0(0)	*(0.8)	*(0.8)	1(1.7)	0(0)	0(0)
		Leptophlebiidae	Mayfly	0(0)	*(0.8)	*(0.8)	0(0)	0(0)	0(0)
	Isopoda	Asellidae	Aquatic	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
			Sow Bug	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
	Megaloptera	Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)
	Odonata	Aeshnidae	Dragonfly/ Damselfly	0(0)	1(0.8)	0(0)	0(0)	0(0)	1(1.6)
		Calopterygidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.6)
		Cordulegastridae	Dragonfly/ Damselfly	0(0)	1(0.8)	0(0)	0(0)	0(0)	1(0.8)
	Plecoptera	Chloroperlidae	Stonefly	*(19.5)	*(5.8)	*(2.3)	1(19.8)	0(0)	*(3.3)
		Leuctridae	Stonefly	0(0)	0(0)	0(0)	0(0)	0(0)	1(16.3)
		Nemouridae	Stonefly	*(1.2)	1(3.3)	1(0.8)	1(0.9)	2(6.1)	1(10.6)

<i>PHYLUM</i>	<i>ORDER</i>	<i>FAMILY</i>	<i>COMMON NAME</i>	<i>1995 genera (RA)</i>	<i>2000 genera (RA)</i>	<i>2001 genera (RA)</i>	<i>2002 genera (RA)</i>	<i>2003 genera (RA)</i>	<i>2004 genera (RA)</i>
Trichoptera		Perlidae	Stonefly	0(0)	0(0)	0(0)	1(1.7)	0(0)	1(9.8)
		Perlodidae	Stonefly	1(2.3)	*(0.8)	0(0)	0(0)	0(0)	*(0.8)
		Hydropsychidae	Caddisfly	1(3.5)	0(0)	3(3.8)	2(3.5)	1(0.9)	1(5.7)
		Lepidostomatidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(8.1)
		Limnephilidae	Caddisfly	1(1.2)	0(0)	*(0.8)	0(0)	*(1.7)	*(0.8)
		Odontoceridae	Caddisfly	1(1.2)	0(0)	0(0)	0(0)	0(0)	0(0)
		Philopotamidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.6)
		Uenoidae	Caddisfly	1(1.2)	0(0)	1(0.8)	1(0.9)	1(0.9)	1(4.1)
Mollusca	Veneroida	Sphaeriidae	Bivalve	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Appendix C
Sentinel Sites in the Eastern Piedmont Region

Baisman Run (LOCH-120-S)
Unnamed Tributary to Dipping Pond Run (JONE-109-S)
North Branch Jones Falls (JONE-315-S)
Unnamed Tributary to the Patuxent River (RKGR-119-S)
Unnamed Tributary to Principio Creek (FURN-101-S)
Timber Run (LIBE-102-S)

Baisman Run (*LOCH-120-S*)

Site LOCH-120-S is located on Baisman Run in the Eastern Piedmont region of Maryland. It is in the Loch Raven Reservoir Watershed in Baltimore County. This site was sampled in 1996 and 2000 to 2004. Its watershed is primarily forested (63%), with 37% agriculture.



Baisman Run in spring 2004.

Water Chemistry

Summer water chemistry data collected at Baisman Run (1996 and 2000 to 2004).

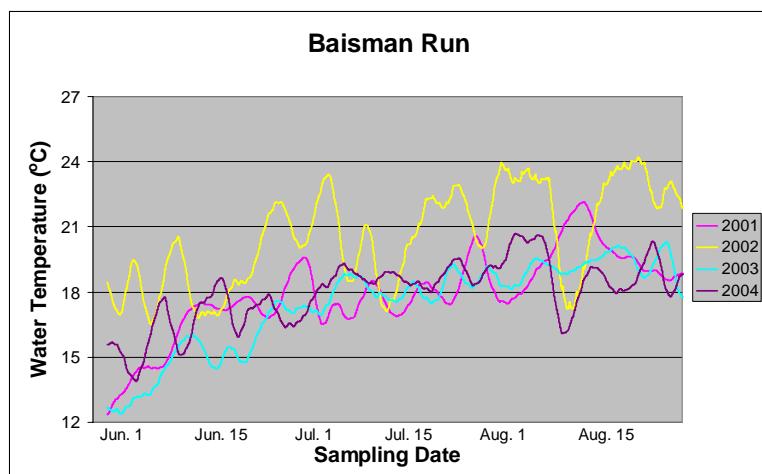
Parameter	1996	2000	2001	2002	2003	2004
Field pH	7.1	7.2	6.7	7.3	7.2	6.9
Dissolved Oxygen (mg/L)	9.6	9.2	8.7	8.3	8.8	7.7
Conductivity (mS)	0.11	0.12	0.13	0.13	0.13	0.12
Turbidity (NTU)	Not measured	1.8	1.3	0.5	5.8	1.5

Physical Habitat

Physical habitat measurements collected at Baisman Run (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	16	16	16	16	16	18
Epifaunal substrate (0-20)	12	16	17	17	17	18
Velocity/Depth Diversity (0-20)	10	8	10	9	10	10
Pool Quality (0-20)	10	9	10	9	10	10
Riffle Quality (0-20)	15	17	15	15	14	15
Shading (%)	95	95	95	98	95	95
Embeddedness (%)	40	20	20	35	35	25
Discharge (cfs)	.83	1.29	.80	.37	5.91	1.15

The graph below displays the temperature logger data for Baisman Run for 2001 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Baisman Run by sampling year.

Parameter	1996	2000	2001	2002	2003	2004
Brook trout	31	19	31	17	2	5
Brown trout	0	1	0	0	1	1
Creek chub	9	41	80	95	13	34
Eastern blacknose dace	44	45	58	51	11	22
Longnose dace	0	20	20	20	1	3
Rosyside dace	0	8	14	25	10	5

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Baisman Run.

Order (Common)	Species
Anura (Frogs and Toads)	Eastern American Toad, Northern Green Frog, Pickerel Frog, Wood Frog
Caudata (Salamanders and Newts)	Eastern Red-backed Salamander, Northern Dusky Salamander, Northern Red Salamander, Northern Two-Lined Salamander, Spotted Salamander
Squamata (Snakes and Lizards)	Eastern Gartersnake, Northern Watersnake

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Baisman Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996	2000	2001	2002	2003	2004
				genera (RA)					
Annelida	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.7)	0(0)
		Naididae	Worm	0(0)	*(2.4)	0(0)	*(1.8)	0(0)	0(0)
Arthropoda	Coleoptera	Dryopidae	Beetle	1(0.9)	0(0)	0(0)	0(0)	0(0)	0(0)
	Coleoptera	Elmidae	Beetle	4(5.7)	24(0)	1(3.2)	2(8.1)	0(0)	0(0)
	Diptera	Ceratopogonidae	True Fly	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)
		Chironomidae	True Fly	6(7.6)	2(1.6)	7(8.8)	5(5.4)	5(9.2)	2(3.17)
		Empididae	True Fly	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)
		Simuliidae	True Fly	1(12.3)	1(18.6)	2(14.4)	2(8.1)	2(64.5)	2(41.3)
		Tipulidae	True Fly	1(0.9)	1(0.8)	2(2.4)	0(0)	1(0.7)	1(0.8)
	Ephemeroptera	Ameletidae	Mayfly	1(2.8)	0(0)	1(1.6)	1(1.8)	1(7.8)	1(2.4)
		Baetidae	Mayfly	1(1.9)	0(0)	0(0)	0(0)	0(0)	0(0)
		Ephemerellidae	Mayfly	1(37.7)	1(55.7)	3(31.2)	2(55.0)	1(5.0)	1(31.8)
		Heptageniidae	Mayfly	1(0.9)	2(8.9)	2(15.2)	1(2.7)	0(0)	1(1.6)
		Leptophlebiidae	Mayfly	1(0.9)	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Plecoptera		Stonefly	0(0)	0(0)	0(0)	*(0.9)	0(0)	0(0)
		Capniidae	Stonefly	0(0)	0(0)	*(0.8)	0(0)	*(5.7)	0(0)
		Leuctridae	Stonefly	0(0)	0(0)	0(0)	0(0)	0(0)	*(1.6)
		Nemouridae	Stonefly	1(14.2)	0(0)	*(8)	1(1.8)	1(4.3)	2(7.1)
		Peltoperlidae	Stonefly	1(1.9)	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Perlidae	Stonefly	1(1.9)	1(0.8)	1(7.2)	1(0.9)	0(0)	0(0)
		Perlodidae	Stonefly	1(3.8)	*(3.2)	0(0)	1(5.4)	0(0)	*(2.4)
		Pteronarcyiidae	Stonefly	1(1.9)	0(0)	1(2.4)	1(3.6)	0(0)	1(1.6)
		Taeniopterygidae	Stonefly	0(0)	1(1.6)	1(0.8)	0(0)	0(0)	1(0.8)
	Trichoptera	Glossosomatidae	Caddisfly	0(0)	0(0)	0(0)	1(1.8)	0(0)	0(0)
		Hydropsychidae	Caddisfly	1(0.9)	0(0)	1(0.8)	1(1.8)	0(0)	1(2.4)
		Lepidostomatidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.7)	1(3.2)
		Limnephilidae	Caddisfly	0(0)	0(0)	1(1.6)	0(0)	0(0)	0(0)
		Polycentropodidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.7)	0(0)
		Rhyacophilidae	Caddisfly	1(0.9)	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Uenoidae	Caddisfly	1(2.8)	0(0)	0(0)	0(0)	1(0.7)	0(0)
Platyhelminthes	Tricladida	Planariidae	Flatworm	0(0)	0(0)	0(0)	1(0.9)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Unnamed Tributary to Dipping Pond Run (JONE-109-S)

Site JONE-109-S is located on an unnamed tributary to Dipping Pond Run in the Eastern Piedmont region of Maryland. It is in the Jones Falls Watershed in Baltimore County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (77%), with 23% agriculture.



Unnamed tributary to Dipping Pond Run in spring 2004.

Water Chemistry

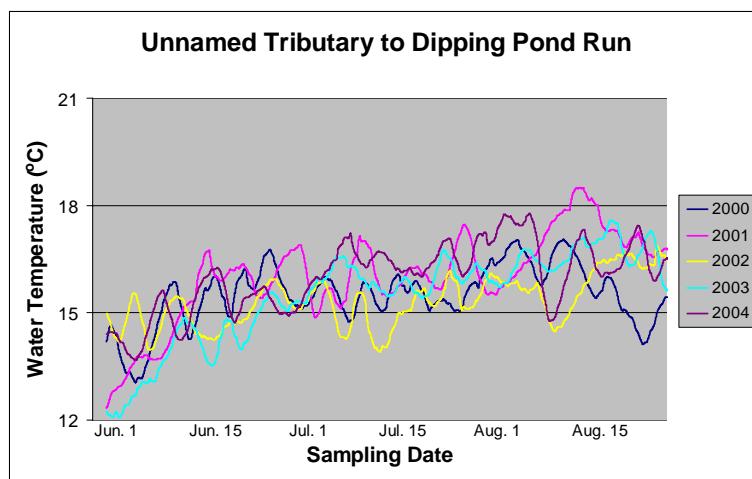
Summer water chemistry data collected at the unnamed tributary to Dipping Pond Run (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	7.5	6.2	6.9	7.8	6.5	6.2
Dissolved Oxygen (mg/L)	8.7	8.1	8.2	6.5	8.3	8.5
Conductivity (mS)	0.12	0.15	0.14	0.14	0.16	0.18
Turbidity (NTU)	Not measured	1.9	2	1.5	2.1	2.4

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to Dipping Pond Run (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	13	12	11	16	16	15
Epifaunal substrate (0-20)	13	11	13	16	18	17
Velocity/Depth Diversity (0-20)	7	8	7	11	11	9
Pool Quality (0-20)	8	6	7	11	11	8
Riffle Quality (0-20)	10	9	11	10	14	11
Shading (%)	95	90	95	95	97	95
Embeddedness (%)	25	25	40	35	15	23
Discharge (cfs)	.07	.12	.08	.06	.26	.10



The above graph displays the temperature logger data for the unnamed tributary to Dipping Pond Run for 2000 to 2004. Maximum recorded temperatures occurred during August 2001.

Biology

Fish

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Dipping Pond Run by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
Brook trout	9	0	0	0	0	0
Brown trout	9	0	0	0	0	2
Eastern blacknose dace	53	41	93	49	28	52

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Dipping Pond Run.

Order (Common)	Species
Anura (Frogs and Toads)	Eastern American Toad, Gray Tree Frog, Northern Green Frog, Pickerel Frog, Wood Frog
Caudata (Salamanders and Newts)	Eastern Red-backed Salamander, Northern Dusky Salamander, Northern Red Salamander
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Dipping Pond Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Annelida	Enchytracidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)
		Naididae	Worm	0(0)	*(5.9)	*(5.5)	*(20.2)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	0(0)	0(0)	0(1.0)
	Coleoptera	Elmidae	Beetle	1(5.5)	1(1.7)	1(6.3)	0(0)	0(0)	0(0)
		Hydrophilidae	Beetle	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)
	Coleoptera	Ptilodactylidae	Beetle	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)
		Collembola		0(0)	*(0.8)	0(0)	0(0)	0(0)	0(0)
	Diptera	Isotomidae		0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)
		Ceratopogonidae	True Fly	0(0)	0(0)	*(1.6)	0(0)	1(4.1)	0(0)
		Chironomidae	True Fly	1(0.8)	3(12.6)	8(14.2)	3(3.7)	6(24.6)	10(31.4)
		Empididae	True Fly	1(3.6)	0(0)	1(0.8)	1(0.8)	0(0)	2(2.0)
		Simuliidae	True Fly	1(1.6)	0(0)	0(0)	0(0)	2(4.1)	2(3.9)
		Tabanidae	True Fly	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)
		Tipulidae	True Fly	0(0)	2(1.7)	1(0.8)	2(2.2)	3(3.3)	3(7.8)
	Ephemeroptera	Ameletidae	Mayfly	1(0.8)	1(5.0)	0(0)	0(0)	0(0)	1(1.0)
		Baetidae	Mayfly	1(20.5)	*(0.8)	1(1.6)	*(1.5)	*(0.8)	1(5.8)
		Ephemerellidae	Mayfly	1(36.2)	2(24.4)	1(27.6)	1(18.67)	2(17.2)	0(0)
		Heptageniidae	Mayfly	1(0.8)	1(0.8)	1(3.2)	1(0.76)	1(6.6)	1(2.9)
		Leptophlebiidae	Mayfly	1(0.8)	1(1.7)	0(0)	0(0)	0(0)	0(0)
Megaloptera	Megaloptera	Corydalidae	Alderfly/ Fishfly	1(0.8)	1(0.8)	1(0.8)	0(0)	1(0.8)	0(0)
		Sialidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)
	Odonata	Cordulegastridae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	1(0.8)	1(0.8)	0(0)
		Chloroperlidae	Stonefly	0(0)	0(0)	0(0)	*(0.8)	0(0)	0(0)
		Leuctridae	Stonefly	1(12.6)	*(5.0)	*(3.2)	1(9.7)	1(3.3)	1(2.9)
Trichoptera	Plecoptera	Nemouridae	Stonefly	1(7.1)	1(22.7)	1(17.3)	1(11.9)	1(1.6)	1(5.9)
		Peltoperlidae	Stonefly	0(0)	1(0.8)	0(0)	1(0.8)	1(0.8)	0(0)
		Perlidae	Stonefly	1(0.8)	0(0)	0(0)	0(0)	1(3.3)	1(2.9)
		Perlodidae	Stonefly	1(3.9)	1(8.4)	*(3.1)	*(6.0)	*(2.5)	1(6.9)
		Glossosomatidae	Caddisfly	0(0)	0(0)	0(0)	1(0.8)	0(0)	1(1.0)
	Trichoptera	Hydropsychidae	Caddisfly	1(0.8)	1(5.0)	1(9.5)	1(7.5)	2(17.2)	2(15.7)
		Limnephilidae	Caddisfly	0(0)	0(0)	1(1.6)	0(0)	0(0)	1(2.9)
		Philopotamidae	Caddisfly	0(0)	1(0.8)	*(0.8)	1(6.0)	0(0)	0(0)
		Rhyacophilidae	Caddisfly	1(2.4)	0(0)	1(0.8)	1(1.5)	1(1.6)	0(0)
		Uenoidae	Caddisfly	0(0)	1(0.8)	1(1.6)	1(3.7)	1(3.3)	1(3.9)
Mollusca	Veneroida	Sphaeriidae	Bivalve	1(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)
Platyhelminthes	Tricladida	Planariidae	Flatworm	1(0.8)	0(0)	0(0)	0(0)	*(1.6)	*(1.0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

North Branch of Jones Falls (JONE-315-S)

Site JONE-315-S is located on the North Branch of Jones Falls in the Eastern Piedmont region of Maryland. It is in the Jones Falls Watershed in Baltimore County. This site was sampled in 1996 and 2000 to 2004. Its watershed is primarily forested (56%), with 34% agriculture, 6% barren, and 4% urban.



North Branch of Jones Falls in spring 2004.

Water Chemistry

Summer water chemistry data collected at the North Branch of Jones Falls (1996 and 2000 to 2004).

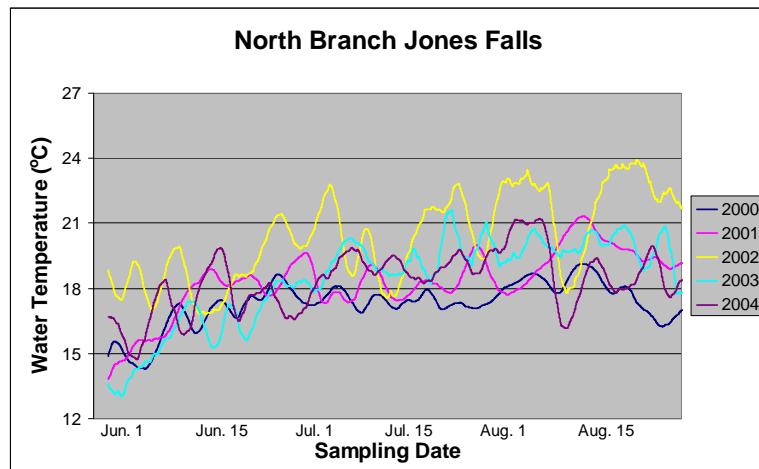
Parameter	1996	2000	2001	2002	2003	2004
Field pH	7.4	7.6	7.4	7.8	7.5	7.7
Dissolved Oxygen (mg/L)	8.3	10.1	8.6	8.7	8.8	7.8
Conductivity (mS)	0.18	0.22	0.23	0.26	0.22	0.23
Turbidity (NTU)	Not measured	3.6	4.5	1.2	3.8	2.6

Physical Habitat

Physical habitat measurements collected at the North Branch of Jones Falls (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	19	17	17	19	19	18
Epifaunal substrate (0-20)	18	17	18	19	18	16
Velocity/Depth Diversity (0-20)	18	15	15	15	17	16
Pool Quality (0-20)	17	16	16	19	17	17
Riffle Quality (0-20)	16	17	17	17	17	17
Shading (%)	87	95	83	96	98	80
Embeddedness (%)	20	15	20	16	20	15
Discharge (cfs)	6.85	2.77	3.05	.59	8.44	4.73

The graph below displays the temperature logger data for the North Branch of Jones Falls for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in the North Branch of Jones Falls by sampling year.

Parameter	1996	2000	2001	2002	2003	2004
Bluegill	2	0	5	4	6	4
Brown trout	45	94	111	81	24	57
Creek chub	20	26	23	9	13	32
Cutlips minnow	8	13	7	6	11	27
Eastern blacknose dace	41	162	105	35	39	101
Green sunfish	3	16	9	2	8	108
Largemouth bass	0	0	7	4	0	1
Longnose dace	23	128	109	62	34	81
Rock bass	0	5	0	1	0	0
Rosyside dace	11	15	11	9	10	4
Smallmouth bass	1	0	0	0	0	0
Tessellated darter	2	20	17	7	13	12
White sucker	30	49	29	33	23	39

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the North Branch of Jones Falls.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Northern Green Frog, Pickerel Frog, Wood Frog
Caudata (Salamanders and Newts)	Eastern Red-backed Salamander, Northern Dusky Salamander, Northern Two-Lined Salamander,
Squamata (Snakes and Lizards)	Northern Watersnake
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the North Branch of Jones Falls by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaixida	Naididae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.9)	0(0)
	Lumbriculida	Lumbriculidae	Worm	*(1.1)	0(0)	0(0)	0(0)	0(0)	*(0.9)
Annelida	Tubificida	Tubificidae	Worm	0(0)	0(0)	*(1.8)	0(0)	0(0)	0(0)
	Arthropoda	Coleoptera	Elmidae	Beetle	1(6.3)	0(0)	1(0.9)	2(1.7)	2(1.7)
		Psephenidae	Beetle	0(0)	0(0)	0(0)	1(0.9)	0(0)	0(0)
Diptera		Chironomidae	True Fly	7(9.5)	7(16.3)	4(14.3)	2(1.7)	4(17.2)	5(12.3)
		Empididae	True Fly	1(1.1)	1(1.6)	0(0)	0(0)	0(0)	0(0)
		Simuliidae	True Fly	1(24.2)	2(13.0)	1(33.0)	2(27.1)	1(61.2)	2(12.3)
		Tipulidae	True Fly	1(1.1)	1(0.8)	0(0)	0(0)	0(0)	2(6.1)
Ephemeroptera		Amelletidae	Mayfly	0(0)	1(3.3)	0(0)	0(0)	0(0)	0(0)
		Baetidae	Mayfly	1(5.3)	*(0.8)	*(0.9)	*(0.9)	0(0)	1(21.9)
		Ephemerellidae	Mayfly	2(17.9)	3(40.7)	1(34.8)	2(47.5)	2(7.8)	1(16.7)
		Heptageniidae	Mayfly	2(6.3)	1(1.6)	1(1.8)	2(3.4)	1(1.7)	0(0)
Megaloptera		Isonychiidae	Mayfly	1(5.3)	1(0.8)	0(0)	0(0)	1(0.9)	0(0)
		Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	1(3.4)	1(0.9)	1(0.9)
Odonata	Gomphidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)	
Plecoptera		Capniidae	Stonefly	0(0)	0(0)	1(0.9)	0(0)	1(0.9)	0(0)
		Leuctridae	Stonefly	0(0)	*(1.6)	*(1.8)	0(0)	0(0)	0(0)
		Nemouridae	Stonefly	1(15.8)	1(2.4)	1(4.5)	0(0)	1(1.7)	1(4.4)
		Perlidae	Stonefly	*(2.1)	1(1.6)	0(0)	0(0)	0(0)	0(0)
		Perlodidae	Stonefly	*(1.1)	*(4.9)	*(1.8)	*(0.9)	0(0)	0(0)
		Taeniopterygidae	Stonefly	0(0)	0(0)	2(3.6)	0(0)	1(0.9)	1(5.3)
Trichoptera		Hydropsychidae	Caddisfly	1(1.1)	2(8.9)	0(0)	3(9.3)	2(2.6)	3(7.9)
		Philopotamidae	Caddisfly	0(0)	*(0.8)	0(0)	1(0.9)	1(0.9)	2(4.4)
		Psychomyiidae	Caddisfly	0(0)	0(0)	0(0)	1(0.9)	0(0)	0(0)
		Rhyacophilidae	Caddisfly	1(2.1)	1(0.8)	0(0)	1(1.7)	0(0)	1(6.1)
		Uenoidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Unnamed Tributary to the Patuxent River (RKGR-119-S)

Site RKGR-119-S is located on an unnamed tributary to the Patuxent River in the Eastern Piedmont region of Maryland. It is in the Rocky Gorge Dam Watershed in Howard County. This site was sampled in 1997 and 2000 to 2004. Its watershed is primarily forested (67%), with 33% agriculture.



Unnamed tributary to the Patuxent River in spring 2004.

Water Chemistry

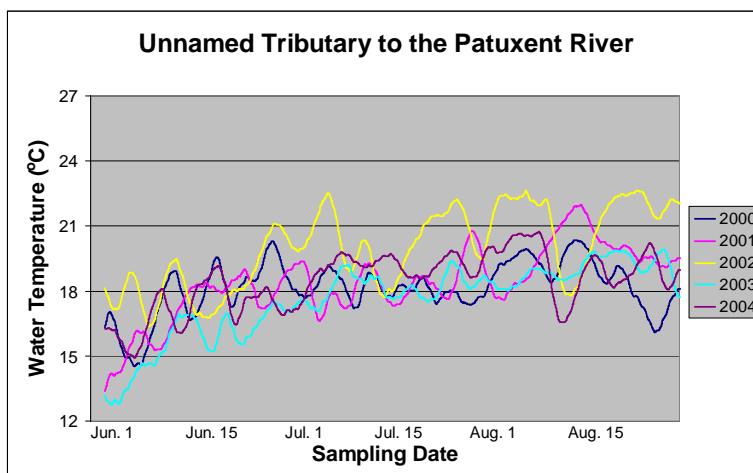
Summer water chemistry data collected at the unnamed tributary to the Patuxent River (1997 and 2000 to 2004).

Parameter	1997	2000	2001	2002	2003	2004
Field pH	7.6	7.6	7.2	7.3	7.3	8.3
Dissolved Oxygen (mg/L)	9.6	8.2	8.2	7	7.9	8
Conductivity (mS)	0.16	0.17	0.17	0.21	0.18	0.19
Turbidity (NTU)	Not measured	7.0	2.7	2.6	2.3	1.4

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to the Patuxent River (1997 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1997	2000	2001	2002	2003	2004
Instream habitat (0-20)	14	16	16	16	18	18
Epifaunal substrate (0-20)	16	17	17	16	18	19
Velocity/Depth Diversity (0-20)	14	14	14	13	14	14
Pool Quality (0-20)	12	12	11	13	14	14
Riffle Quality (0-20)	14	16	14	12	16	14
Shading (%)	90	90	95	95	93	95
Embeddedness (%)	30	35	25	18	10	15
Discharge (cfs)	.62	1.35	.97	.17	1.58	.85



The graph above displays the temperature logger data for the unnamed tributary to the Patuxent River for 2000 to 2004. Maximum recorded temperatures occurred during the drought in July and August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in the unnamed tributary to the Patuxent River by sampling year.

Parameter	1997	2000	2001	2002	2003	2004
Blue ridge sculpin	25	111	283	233	87	121
Bluegill	1	9	10	0	5	0
Brown bullhead	0	0	1	0	0	0
Central stoneroller	0	0	0	0	0	1
Creek chub	1	16	5	56	9	0
Eastern blacknose dace	17	82	56	178	160	111
Fallfish	1	7	1	1	1	0
Green sunfish	0	0	0	0	2	0
Largemouth bass	0	1	0	0	1	0
Longnose dace	24	11	9	9	3	6
Rosyside dace	4	16	5	28	40	25
Tessellated darter	1	3	2	0	0	0
White sucker	2	2	2	1	2	0
Yellow bullhead	2	0	0	0	0	2

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna collected in or near the unnamed tributary to the Patuxent River.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Northern Green Frog, Pickerel Frog, Wood Frog
Caudata (Salamanders and Newts)	Northern Red Salamander, Northern Two-Lined Salamander, Spotted Salamander
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to the Patuxent River by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME (RA)	1997 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaidea	Naididae	Worm	0(0)	0(0)	0(0)	*(1.0)	*(2.4)	0(0)
Arthropoda	Coleoptera	Dryopidae	Beetle	0(0)	0(0)	1(0.7)	0(0)	0(0)	0(0)
		Elmidae	Beetle	1(1.1)	0(0)	0(0)	0(0)	1(0.8)	0(0)
	Diptera	Ptilodactylidae	Beetle	0(0)	0(0)	1(0.7)	0(0)	0(0)	1(1.1)
		Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)
		Chironomidae	True Fly	3(9.1)	3(3.6)	8(10.4)	12(22.9)	6(5.5)	10(16.5)
		Empididae	True Fly	2(3.4)	1(0.9)	0(0)	0(0)	1(0.8)	1(1.1)
		Simuliidae	True Fly	2(4.6)	2(10.9)	1(34.0)	1(22.0)	2(44.1)	1(27.5)
		Tipulidae	True Fly	1(1.1)	0(0)	1(1.4)	1(1.0)	2(1.6)	3(4.4)
	Ephemeroptera	Ameletidae	Mayfly	1(3.4)	1(2.7)	1(0.7)	0(0)	0(0)	0(0)
		Baetidae	Mayfly	1(2.3)	*(1.8)	*(0.7)	0(0)	0(0)	*(2.2)
		Ephemerellidae	Mayfly	1(52.3)	1(59.1)	1(31.3)	1(28.6)	1(26.0)	1(15.4)
		Heptageniidae	Mayfly	0(0)	*(2.7)	*(3.5)	0(0)	1(0.8)	1(1.1)
	Megaloptera	Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	0(0)	1(0.8)	1(2.2)
	Odonata	Gomphidae	Dragonfly/ Damselfly	0(0)	*(0.9)	*(0.7)	*(1.0)	0(0)	0(0)
	Plecoptera	Leuctridae	Stonefly	1(1.1)	0(0)	0(0)	0(0)	0(0)	*(1.1)
		Nemouridae	Stonefly	2(9.1)	1(12.7)	1(4.9)	1(11.4)	2(5.5)	1(2.2)
		Perlidae	Stonefly	1(1.1)	0(0)	*(1.4)	0(0)	0(0)	1(3.3)
	Trichoptera	Perlodidae	Stonefly	1(2.3)	*(1.8)	0(0)	*(1.0)	0(0)	*(3.3)
		Glossosomatidae	Caddisfly	1(2.3)	0(0)	0(0)	0(0)	0(0)	0(0)
		Hydropsychidae	Caddisfly	2(3.4)	2(1.8)	3(5.6)	2(1.9)	2(2.4)	3(11.0)
		Philopotamidae	Caddisfly	1(2.3)	0(0)	1(0.7)	1(1.9)	0(0)	2(4.4)
		Polycentropodidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	*(1.1)
		Psychomyiidae	Caddisfly	0(0)	0(0)	1(0.7)	0(0)	0(0)	0(0)
		Rhyacophilidae	Caddisfly	0(0)	0(0)	1(0.7)	1(3.8)	1(0.8)	0(0)
Nematomorpha	Gordioidea	Uenoidae	Caddisfly	1(1.1)	1(0.9)	1(2.1)	1(1.9)	1(7.1)	1(2.2)
Platyhelminthes	Tricladida	Planariidae	Flatworm	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Unnamed Tributary to Principio Creek (FURN-101-S)

Site FURN-101-S is located on an unnamed tributary to Principio Creek in the Eastern Piedmont region of Maryland. It is in the Furnace Bay Watershed in Cecil County. This site was sampled in 2000 to 2004. Its watershed is primarily forested (86%), with 9% agriculture and 3% barren.



Unnamed tributary to Principio Creek in spring 2004.

Water Chemistry

Summer water chemistry data collected at the unnamed tributary to Principio Creek (2000 to 2004).

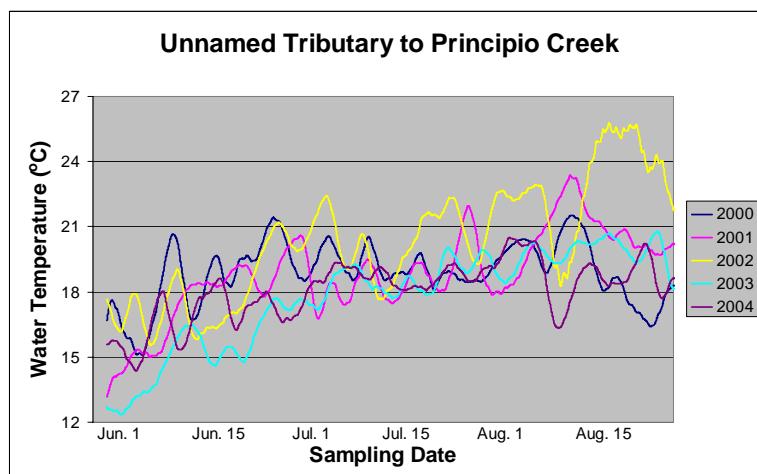
Parameter	2000	2001	2002	2003	2004
Field pH	6.7	6.6	6.8	5.7	7.7
Dissolved Oxygen (mg/L)	8.5	8.1	6.7	7.6	7.8
Conductivity (mS)	0.07	0.06	0.07	0.07	0.07
Turbidity (NTU)	1.3	0.9	1.6	0.4	1.6

Physical Habitat

Physical habitat measurements collected at the unnamed tributary to Principio Creek (2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	2000	2001	2002	2003	2004
Instream habitat (0-20)	16	16	16	15	16
Epifaunal substrate (0-20)	16	16	16	16	16
Velocity/Depth Diversity (0-20)	14	13	14	13	13
Pool Quality (0-20)	14	12	15	14	14
Riffle Quality (0-20)	15	14	14	15	15
Shading (%)	92	95	96	95	90
Embeddedness (%)	10	25	10	15	5
Discharge (cfs)	.84	.47	.12	.77	2.28

The graph displays the temperature logger data for the unnamed tributary to Principio Creek for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Principio Creek by sampling year.

Parameter	2000	2001	2002	2003	2004
American eel	22	25	26	16	33
Blue ridge sculpin	40	73	49	2	3
Creek chub	49	60	56	29	58
Cutlip minnow	3	0	0	4	7
Eastern blacknose dace	83	99	71	58	159
Margined madtom	4	1	3	1	0
Rosyside dace	107	125	168	80	199
Tessellated darter	0	1	4	0	3
White sucker	1	2	4	0	3

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Principio Creek.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Fowler's Toad, Northern Green Frog, Pickerel Frog
Caudata (Salamanders and Newts)	Eastern Red-backed Salamander, Northern Dusky Salamander, Northern Red Salamander, Northern Two-Lined Salamander
Squamata (Snakes and Lizards)	Northern Watersnake
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the Unnamed Tributary to Principio Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Annelida	Enchytraeidae	Worm	0(0)	0(0)	*(0.7)	0(0)	0(0)
		Naididae	Worm	*(4)	0(0)	0(0)	0(0)	0(0)
	Diptera	Lumbriculidae	Worm	0(0)	0(0)	0(0)	*(2.3)	*(1.6)
		Tubificidae	Worm	0(0)	0(0)	0(0)	0(0.8)*	0(0)
	Coleoptera	Elmidae	Beetle	1(1.6)	2(6.7)	2(2.2)	1(0.8)	0(0)
		Psephenidae	Beetle	1(3.2)	0(0)	0(0)	0(0)	0(0)
	Ephemeroptera	Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	1(0.8)	0(0)
		Chironomidae	True Fly	5(16.8)	5(5.0)	6(9.6)	4(10.2)	2(4.8)
	Odonata	Simuliidae	True Fly	2(9.6)	1(31.1)	2(19.1)	2(28.9)	1(25.6)
		Tipulidae	True Fly	2(1.6)	2(1.7)	2(1.5)	2(3.1)	2(4)
Mollusca	Plecoptera	Ameletidae	Mayfly	0(0)	0(0)	0(0)	1(7.8)	1(0.8)
		Baetidae	Mayfly	1(0.8)	*(0.8)	1(2.2)	0(0)	0(0)
	Trichoptera	Ephemerellidae	Mayfly	2(36.0)	2(38.7)	2(30.2)	1(9.4)	1(13.6)
		Heptageniidae	Mayfly	2(1.6)	1(2.5)	1(5.9)	1(0.8)	1(9.6)
	Basommatophora	Leptophlebiidae	Mayfly	0(0)	*(0.8)	1(11.0)	*(0.8)	0(0)
		Gomphidae	Dragonfly/Damselfly	*(1.6)	0(0)	*(2.2)	0(0)	0(0)
	Veneroida	Chloroperlidae	Stonefly	0(0)	0(0)	0(0)	0(0)	*(0.8)
		Leuctridae	Stonefly	1(9.6)	1(0.8)	*(0.7)	1(18.8)	1(26.4)
	Planariidae	Nemouridae	Stonefly	1(2.4)	1(3.4)	2(7.4)	2(10.2)	1(1.6)
		Perlidae	Stonefly	0(0)	1(2.5)	*(0.7)	0(0)	2(2.4)
	Tricladida	Perlodidae	Stonefly	2(4.8)	*(4.2)	*(2.2)	*(1.6)	*(8)
		Brachycentridae	Caddisfly	*(0.8)	0(0)	0(0)	0(0)	0(0)
Platyhelminthes	Sphaeriidae	Glossosomatidae	Caddisfly	0(0)	1(0.8)	1(0.7)	0(0)	0(0)
		Hydropsychidae	Caddisfly	0(0)	1(0.8)	0(0)	1(0.8)	0(0)
	Acanthocephala	Lepidostomatidae	Caddisfly	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Odontoceridae	Caddisfly	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Gastropoda	Philopotamidae	Caddisfly	*(2.4)	0(0)	0(0)	1(0.8)	*(0.8)
		Polycentropodidae	Caddisfly	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Clitellata	Rhyacophilidae	Caddisfly	0(0)	0(0)	1(0.7)	0(0)	0(0)
		Uenoidae	Caddisfly	0(0)	0(0)	1(2.9)	0(0)	0(0)
	Bivalvia	Ancylidae	Snail	0(0)	0(0)	0(0)	1(0.8)	0(0)
		Sphaeriidae	Bivalve	*(0.8)	0(0)	0(0)	*(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Timber Run (LIBE-102-S)

Site LIBE-102-S is located on Timber Run in the Eastern Piedmont region of Maryland. It is in the Liberty Reservoir Watershed in Baltimore County. This site was sampled in 2000 to 2004. Its watershed is primarily forested (75%), with 25% agriculture.



Timber Run in spring 2004.

Water Chemistry

Summer water chemistry data collected at Timber Run (2000 to 2004).

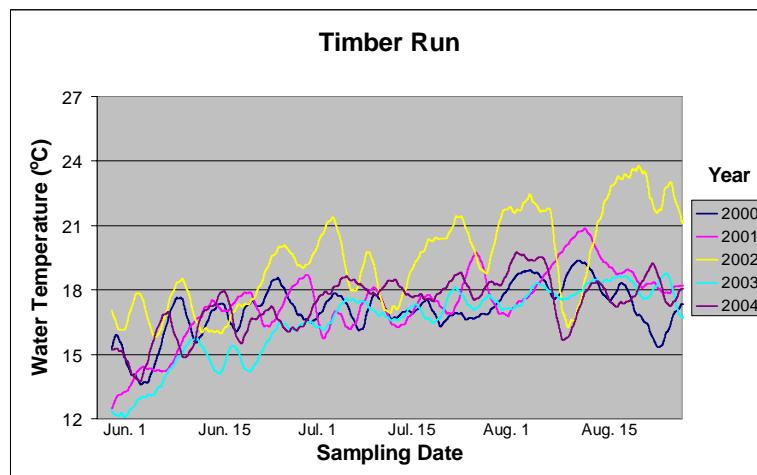
Parameter	2000	2001	2002	2003	2004
Field pH	9.3	8.4	7.5	9.4	8.0
Dissolved Oxygen (mg/L)	8.6	6.7	6.7	6.9	7.6
Conductivity (mS)	0.10	0.10	0.09	0.10	0.10
Turbidity (NTU)	1.3	2.2	1.6	3.4	2

Physical Habitat

Physical habitat measurements collected at Timber Run (2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	2000	2001	2002	2003	2004
Instream habitat (0-20)	18	17	16	17	16
Epifaunal substrate (0-20)	18	17	17	16	15
Velocity/Depth Diversity (0-20)	12	15	10	10	12
Pool Quality (0-20)	15	16	10	10	13
Riffle Quality (0-20)	15	13	14	15	14
Shading (%)	95	88	95	96	95
Embeddedness (%)	12	25	35	20	30
Discharge (cfs)	.63	.52	.34	1.93	.79

The graph below displays the temperature logger data for Timber Run for 2000 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Timber Run by sampling year.

Parameter	2000	2001	2002	2003	2004
Blue ridge sculpin	180	250	162	51	157
Brook trout	18	2	17	3	0
Creek chub	53	52	29	16	61
Eastern blacknose dace	120	128	77	35	72
Rosyside dace	34	45	18	8	29

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Timber Run.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Eastern American Toad, Northern Green Frog, Pickerel Frog, Southern Leopard Frog, Wood Frog
Caudata (Salamanders and Newts)	Eastern Red-backed Salamander, Northern Dusky Salamander, Northern Red Salamander, Northern Two-Lined Salamander,
Squamata (Snakes and Lizards)	Northern Ringneck Snake
Testudines (Turtles)	Eastern Box Turtle

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Timber Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Arthropoda	Haplotauxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	*(0.8)	0(0)
		Naaididae	Worm	*(0.8)	0(0)	*(0.9)	0(0)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	*(0.8)	0(0)
	Coleoptera	Dryopidae	Beetle	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Elmidae	Beetle	2(2.4)	1(3.1)	2(8.6)	1(0.8)	0(0)
		Psephenidae	Beetle	0(0)	1(0.8)	0(0)	0(0)	0(0)
		Ptilodactylidae	Beetle	0(0)	0(0)	1(0.9)	1(0.8)	1(0.7)
	Diptera	Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	2(1.7)	0(0)
		Chironomidae	True Fly	3(4.0)	10(12.2)	9(42.7)	10(24.4)	6(12.6)
		Dixidae	True Fly	0(0)	1(1.5)	1(0.9)	0(0)	0(0)
		Empididae	True Fly	0(0)	0(0)	1(0.9)	0(0)	1(0.7)
		Simuliidae	True Fly	2(17.5)	1(48.9)	2(3.4)	1(23.5)	1(35.7)
	Ephemeroptera	Tipulidae	True Fly	1(0.8)	1(2.3)	1(1.7)	4(5.9)	3(4.2)
		Baetidae	Mayfly	1(2.4)	0(0)	*(1.7)	0(0)	1(7.7)
		Ephemerellidae	Mayfly	2(38.1)	2(6.1)	2(26.5)	1(11.8)	1(6.3)
		Heptageniidae	Mayfly	2(2.4)	2(2.3)	*(0.85)	2(6.7)	1(4.9)
	Megaloptera	Leptophlebiidae	Mayfly	0(0)	2(2.3)	0(0)	*(0.8)	0(0)
		Corydalidae	Alderfly/ Fishfly	0(0)	1(0.8)	0(0)	1(1.7)	1(0.7)
	Odonata	Aeshnidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	0(0)	1(0.7)
		Gomphidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	*(0.8)	0(0)
	Plecoptera	Leuctridae	Stonefly	*(4.8)	0(0)	*(0.9)	0(0)	*(2.8)
		Nemouridae	Stonefly	1(13.5)	1(13.7)	1(1.7)	1(7.6)	1(5.6)
		Peltoperlidae	Stonefly	0(0)	0(0)	0(0)	0(0)	1(0.7)
		Perlidae	Stonefly	0(0)	0(0)	0(0)	0(0)	2(2.1)
		Perlodidae	Stonefly	*(3.2)	0(0)	0(0)	0(0)	1(4.2)
		Pteronarcyidae	Stonefly	0(0)	0(0)	1(0.9)	0(0)	0(0)
	Trichoptera		Caddisfly	0(0)	0(0)	*(0.9)	0(0)	0(0)
		Hydropsychidae	Caddisfly	2(2.4)	0(0)	0(0)	1(2.5)	3(6.3)
		Lepidostomatidae	Caddisfly	0(0)	0(0)	1(0.9)	0(0)	0(0)
		Limnephilidae	Caddisfly	0(0)	2(1.5)	0(0)	0(0)	1(2.1)
		Philopotamidae	Caddisfly	1(4.0)	0(0)	0(0)	0(0)	0(0)
		Polycentropodidae	Caddisfly	0(0)	*(0.8)	1(0.9)	1(0.8)	0(0)
		Psychomyiidae	Caddisfly	0(0)	0(0)	0(0)	1(0.8)	1(0.7)
		Rhyacophilidae	Caddisfly	1(0.8)	0(0)	1(0.9)	1(1.7)	0(0)
		Uenoidae	Caddisfly	1(2.4)	1(3.8)	1(3.4)	1(4.)	1(1.4)
Platyhelminthes	Tricladida	Planariidae	Flatworm	0(0)	0(0)	1(0.9)	*(1.7)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Appendix D
Sentinel Sites in the Highlands Region

Bear Creek (YOUNG-432-S)
Buzzard Branch (UMON-119-S)
Crabtree Creek (SAVA-204-S)
Double Lick Run (SAVA-276-S)
Fifteenmile Creek (FIMI-207-S)
High Run (UMON-288-S)
Mill Run (PRLN-626-S)
Savage River (SAVA-225-S)

Bear Creek (YOUNG-432-S)

Site YOUNG-432-S is located on Bear Creek in the Highlands region of Maryland. It is in the Youghiogheny River Watershed in Garrett County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (76%), with 23% agriculture.



Bear Creek in spring 2004.

Water Chemistry

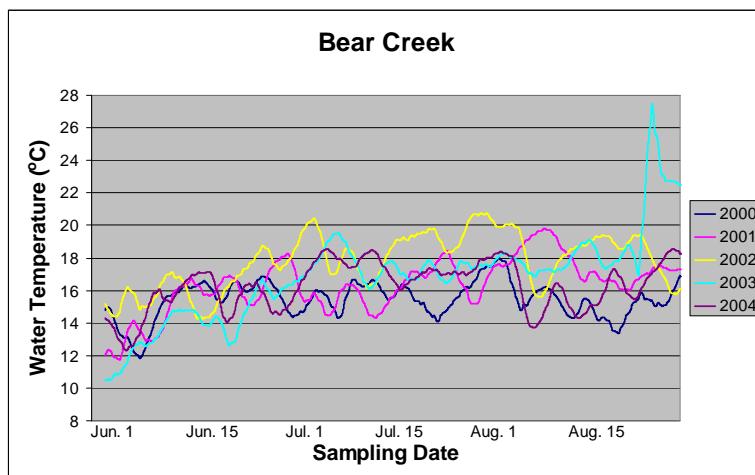
Summer water chemistry data collected at Bear Creek (1995 and 2000 to 2004).

Parameter	1995	2000	2001	2002	2003	2004
Field pH	7.3	7.5	7.2	6.8	7.2	6.3
Dissolved Oxygen (mg/L)	7.4	8.5	8	10.7	7.9	8.9
Conductivity (mS)	0.07	0.05	0.07	0.08	0.07	0.07
Turbidity (NTU)	Not measured	8	3.4	6.4	5.8	5.8

Physical Habitat

Physical habitat measurements collected at Bear Creek (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	17	18	18	18	16	16
Epifaunal substrate (0-20)	19	18	17	15	14	14
Velocity/Depth Diversity (0-20)	14	12	17	10	9	15
Pool Quality (0-20)	16	13	16	17	9	14
Riffle Quality (0-20)	18	18	17	17	16	11
Shading (%)	80	85	85	92	93	88
Embeddedness (%)	25	10	20	35	35	35
Discharge (cfs)	4.04	2.55	2.86	1.33	1.16	2.00



The above graph displays the temperature logger data for Bear Creek for 2000 to 2004. The temperature spike observed in August 2003 resulted from removing the temperature logger before the end of the month.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Bear Creek by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
Brook trout	59	12	29	20	8	32
Creek chub	0	0	0	0	10	8
Eastern blacknose dace	142	4	29	11	100	60
Longnose dace	4	0	0	0	0	0
Mottled sculpin	477	190	279	265	287	239
Rainbow trout	5	0	0	0	0	0
White sucker	11	1	0	1	24	28

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Bear Creek.

Order (Common)	Species
Caudata (Salamanders and Newts)	Allegheny Mountain Dusky Salamander, Northern Dusky Salamander, Northern Two-Lined Salamander

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Bear Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	*(1.7)	0(0)	0(0)
Arthropoda	Amphipoda	Gammaridae	Scud	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Coleoptera	Elmidae	Beetle	2(6.9)	1(2.4)	2(5.1)	2(11.7)	1(10.8)	1(2.8)
		Psephenidae	Beetle	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Decapoda	Cambaridae	Crayfish	*(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)
	Diptera	Blephariceridae	True Fly	1(0.8)	1(4.0)	0(0)	0(0)	0(0)	1(2.0)
		Ceratopogonidae	True Fly	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Chironomidae	True Fly	11(38.2)	4(11.1)	5(10.3)	1(15.0)	1(5.4)	0(0)
		Empididae	True Fly	2(2.3)	0(0)	0(0)	0(0)	1(0.8)	0(0)
		Simuliidae	True Fly	1(3.8)	1(3.2)	1(21.4)	1(5.8)	1(20.0)	1(0.9)
	Ephemeroptera	Tipulidae	True Fly	2(3.1)	2(2.4)	2(1.7)	2(1.7)	2(2.3)	2(1.9)
		Baetidae	Mayfly	1(11.5)	2(8.0)	1(4.3)	2(1.7)	2(9.2)	2(11.3)
		Ephemerellidae	Mayfly	1(16.0)	2(14.3)	1(6.0)	1(5.0)	3(18.5)	2(24.5)
		Heptageniidae	Mayfly	1(2.3)	3(16.7)	4(11.1)	3(17.5)	2(7.7)	5(23.6)
		Isonychiidae	Mayfly	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
		Leptophlebiidae	Mayfly	0(0)	1(15.9)	1(12.8)	1(13.3)	1(13.1)	1(13.2)
	Megaloptera	Corydalidae	Alderfly/ Fishfly	1(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)
	Plecoptera	Chloroperlidae	Stonefly	0(0)	*(2.4)	*(2.6)	1(2.5)	0(0)	*(3.8)
		Leuctridae	Stonefly	1(1.5)	1(2.4)	1(2.6)	1(5.0)	1(3.1)	0(0)
		Nemouridae	Stonefly	1(0.8)	1(2.4)	1(7.7)	1(1.7)	1(1.5)	1(1.9)
		Peltoperlidae	Stonefly	0(0)	*(0.8)	0(0)	1(0.8)	0(0)	1(2.8)
		Perlidae	Stonefly	0(0)	0(0)	0(0)	1(0.8)	0(0)	*(1.9)
		Perlodidae	Stonefly	2(3.8)	1(4.0)	1(2.6)	1(2.5)	1(3.1)	*(1.9)
		Pteronarcyidae	Stonefly	1(1.5)	0(0)	0(0)	0(0)	0(0)	0(0)
	Trichoptera	Caddisfly	Caddisfly	0(0)	0(0)	*(0.9)	0(0)	0(0)	0(0)
		Hydropsychidae	Caddisfly	2(2.3)	1(2.4)	2(4.3)	2(9.2)	2(3.9)	2(5.7)
		Lepidostomatidae	Caddisfly	1(1.5)	1(3.2)	0(0)	1(0.8)	0(0)	0(0)
		Limnephilidae	Caddisfly	0(0)	0(0)	1(0.9)	0(0)	0(0)	0(0)
		Philopotamidae	Caddisfly	0(0)	0(0)	1(0.9)	0(0)	0(0)	*(0.9)
		Polycentropodidae	Caddisfly	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)
		Rhyacophilidae	Caddisfly	1(1.5)	1(0.8)	1(1.7)	1(0.8)	0(0)	0(0)
		Uenoidae	Caddisfly	0(0)	1(0.8)	1(3.4)	1(1.7)	1(0.7)	1(0.9)
Mollusca	Venerida	Sphaeriidae	Bivalve	1(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10). * Taxa not identified to genus.

Buzzard Branch (UMON-119-S)

Site UMON-119-S is located on Buzzard Branch in the Highlands region of Maryland. It is in the Upper Monocacy River Watershed in Frederick County. This site was sampled in 2000 and 2002 to 2004. Its watershed is primarily forested (99%), with 1% agriculture.



Buzzard Branch in the spring of 2004.

Water Chemistry

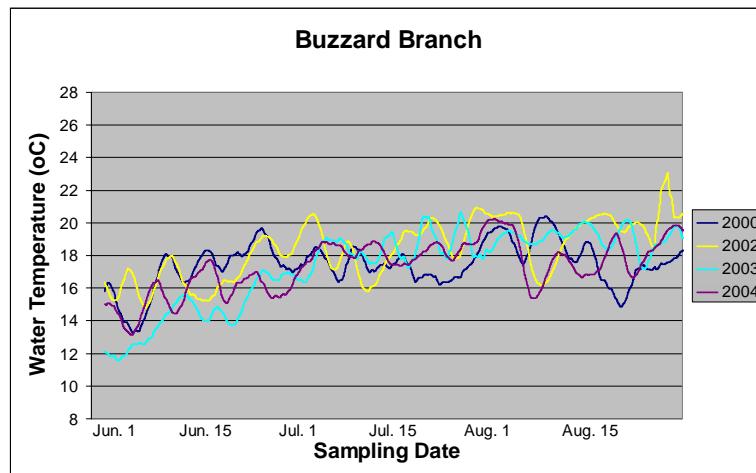
Summer water chemistry data collected at Buzzard Branch (2000 and 2002 to 2004).

Parameter	2000	2002	2003	2004
Field pH	6.9	7.2	7.2	6.2
Dissolved Oxygen (mg/L)	7.3	8.9	8.6	6.6
Conductivity (mS)	0.05	0.08	0.06	0.07
Turbidity (NTU)	3.1	2.8	2.9	3.8

Physical Habitat

Physical habitat measurements collected at Buzzard Branch (2000 and 2002 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	2000	2002	2003	2004
Instream habitat (0-20)	17	17	16	16
Epifaunal substrate (0-20)	18	17	17	17
Velocity/Depth Diversity (0-20)	15	9	10	12
Pool Quality (0-20)	16	9	10	10
Riffle Quality (0-20)	15	14	15	16
Shading (%)	90	86	98	90
Embeddedness (%)	25	20	20	20
Discharge (cfs)	.54	.09	.38	1.39



The graph above displays the temperature logger data for Buzzard Branch for 2000 and 2002 to 2004. Maximum recorded temperatures occurred during the drought in August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Buzzard Branch by sampling year.

Parameter	2000	2002	2003	2004
Eastern blacknose dace	24	33	17	37
Brook trout	19	57	25	43
Brown trout	30	10	2	5

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Buzzard Branch.

Order (Common)	Species
Anura (Frogs and Toads)	American Bullfrog, Pickerel Frog
Caudata (Salamanders and Newts)	Northern Dusky Salamander, Northern Spring Salamander, Northern Two-Lined Salamander

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Buzzard Branch by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

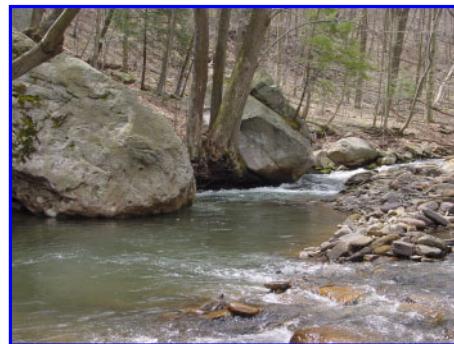
PHYLUM	ORDER	FAMILY	COMMON NAME	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	*(1.6)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	*(0.8)	0(0)
Arthropoda	Coleoptera	Elmidae	Beetle	1(6.6)	1(27.2)	1(0.8)	1(2.2)
	Diptera	Psephenidae	Beetle	0(0)	1(1.6)	1(0.8)	0(0)
		Ceratopogonidae	True Fly	0(0)	0(0)	1(1.6)	0(0)
		Chironomidae	True Fly	4(9.1)	6(14.4)	8(20.5)	7(12.2)
		Empididae	True Fly	0(0)	1(1.6)	0(0)	0(0)
		Simuliidae	True Fly	3(55.4)	1(1.6)	1(8.7)	1(10.0)
		Tipulidae	True Fly	0(0)	2(3.2)	2(7.1)	2(8.9)
	Ephemeroptera	Baetidae	Mayfly	1(3.3)	*(3.2)	*(0.8)	1(27.8)
		Ephemerellidae	Mayfly	1(7.4)	1(8.8)	1(8.7)	1(6.7)
		Heptageniidae	Mayfly	1(1.7)	3(13.6)	2(7.1)	0(0)
		Isonychiidae	Mayfly	0(0)	0(0)	1(0.8)	0(0)
		Leptophlebiidae	Mayfly	1(3.3)	1(6.4)	*(10.2)	1(13.3)
	Megaloptera	Corydalidae	Alderfly/ Fishfly	1(8.)	1(1.6)	1(1.6)	0(0)
	Odonata	Gomphidae	Dragonfly/ Damselfly	1(8.)	0(0)	1(1.6)	0(0)
	Plecoptera		Stonefly	0(0)	0(0)	*(1.6)	0(0)
		Capniidae	Stonefly	0(0)	0(0)	1(0.8)	0(0)
		Chloroperlidae	Stonefly	1(1.7)	1(0.8)	1(7.1)	1(6.7)
		Leuctridae	Stonefly	1(1.7)	*(1.6)	1(1.6)	1(3.3)
		Nemouridae	Stonefly	1(4.1)	1(1.6)	1(0.8)	0(0)
		Peltoperlidae	Stonefly	0(0)	0(0)	1(1.6)	0(0)
		Perlidae	Stonefly	0(0)	0(0)	1(3.9)	1(1.1)
		Perlodidae	Stonefly	1(1.7)	1(2.4)	*(0.8)	1(3.3)
		Pteronarcyidae	Stonefly	0(0)	1(2.4)	0(0)	0(0)
		Taeniopterygidae	Stonefly	0(0)	0(0)	1(0.8)	1(1.1)
	Trichoptera	Hydropsychidae	Caddisfly	1(8.)	1(4)	2(3.9)	2(2.2)
		Philopotamidae	Caddisfly	1(8.)	1(1.6)	1(0.8)	0(0)
		Rhyacophilidae	Caddisfly	1(8.)	1(0.8)	1(3.2)	1(1.1)
		Uenoidae	Caddisfly	0(0)	1(1.6)	1(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Crabtree Creek (SAVA-204-S)

Site SAVA-204-S is located on Crabtree Creek in the Highlands region of Maryland. It is in the Savage River Watershed in Garrett County. This site was sampled in 2000 to 2004. Its watershed is primarily forested (89%), with 10% agriculture.



Crabtree Creek in spring 2004.

Water Chemistry

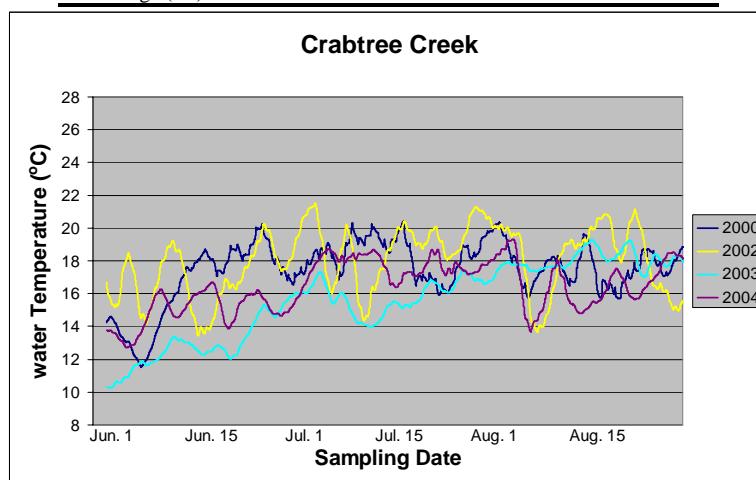
Summer water chemistry data collected at Crabtree Creek (2000 to 2004).

Parameter	2000	2001	2002	2003	2004
Field pH	7.7	7.7	7.6	7.7	7.2
Dissolved Oxygen (mg/L)	9	8.2	9.3	8.6	8.1
Conductivity (mS)	0.14	0.16	0.17	0.13	0.19
Turbidity (NTU)	2	3.1	1.4	1.6	2.2

Physical Habitat

Physical habitat measurements collected at Crabtree Creek (2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	2000	2001	2002	2003	2004
Instream habitat (0-20)	20	19	19	20	18
Epifaunal substrate (0-20)	19	18	16	20	17
Velocity/Depth Diversity (0-20)	15	17	15	17	16
Pool Quality (0-20)	17	18	18	18	18
Riffle Quality (0-20)	17	18	18	19	18
Shading (%)	75	85	85	75	91
Embeddedness (%)	15	15	20	10	30
Discharge (cfs)	3.74	5.38	3.15	8.22	3.80



The above graph displays the temperature logger data for Crabtree Creek for 2000 and 2002 to 2004. Maximum recorded temperatures occurred during the drought in July and August 2002.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Crabtree Creek by sampling year.

Parameter	2000	2001	2002	2003	2004
Blue ridge sculpin	108	169	112	59	44
Bluntnose minnow	0	0	0	0	3
Brook trout	11	170	95	29	22
Brown trout	1	2	1	0	1
Central stoneroller	0	0	0	0	1
Creek chub	0	0	2	0	0
Eastern blacknose dace	18	44	44	53	32
Fantail darter	37	31	13	51	14
Longnose dace	41	18	30	43	48
Potomac sculpin	0	0	0	1	1
Rainbow trout	0	0	0	0	1
Rock bass	0	0	0	37	36
White sucker	12	0	2	7	1

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Crabtree Creek.

Order (Common)	Species
Caudata (Salamanders and Newts)	Northern Dusky Salamander

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Crabtree Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaidea	Naididae	Worm	0(0)	0(0)	0(0)	*(0.8)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	*(1.8)	0(0)	0(0)
Arthropoda	Coleoptera	Elmidae	Beetle	*(1.6)	1(.9)	1(15.2)	1(2.4)	0(0)
	Diptera	Blephariceridae	True Fly	0(0)	0(0)	0(0)	1(1.6)	0(0)
		Ceratopogonidae	True Fly	1(.8)	0(0)	0(0)	0(0)	0(0)
		Chironomidae	True Fly	6(21.8)	3(8.0)	4(23.2)	5(10.3)	6(42.4)
		Dixidae	True Fly	1(.8)	0(0)	0(0)	0(0)	0(0)
		Empididae	True Fly	0(0)	2(1.8)	1(0.9)	*(0.8)	0(0)
		Simuliidae	True Fly	1(1.6)	1(.9)	0(0)	*(0.8)	0(0)
		Tipulidae	True Fly	3(2.4)	1(.9)	0(0)	1(0.8)	0(0)
	Ephemeroptera	Ameletidae	Mayfly	0(0)	1(.9)	0(0)	0(0)	0(0)
		Baetidae	Mayfly	2(8.1)	1(1.8)	2(2.7)	*(15.1)	1(6.8)
		Ephemerellidae	Mayfly	1(21.0)	1(9.8)	1(11.6)	1(27.8)	1(8.5)
		Heptageniidae	Mayfly	2(10.5)	2(29.5)	2(16.1)	2(16.7)	1(10.2)
		Isonychiidae	Mayfly	1(8)	0(0)	0(0)	1(0.8)	0(0)
		Leptophlebiidae	Mayfly	1(4.0)	1(4.5)	1(7.1)	1(4.0)	1(6.8)
	Megaloptera	Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	1(0.8)	0(0)
	Plecoptera	Capniidae	Stonefly	0(0)	1(.9)	0(0)	0(0)	0(0)
		Chloroperlidae	Stonefly	*(4.0)	*(6.3)	1(1.8)	1(2.4)	*(10.2)
		Leuctridae	Stonefly	1(1.6)	0(5.4)	1(6.3)	*(4.0)	*(5.9)
		Nemouridae	Stonefly	1(2.4)	1(1.8)	0(0)	1(3.2)	1(1.7)
		Perlodidae	Stonefly	*(3.2)	1(15.2)	1(2.7)	*(0.8)	1(2.5)
		Pteronarcyidae	Stonefly	1(2.4)	1(1.8)	0(0)	1(0.8)	0(0)
		Taeniopterygidae	Stonefly	1(8)	1(7.1)	1(6.3)	0(0)	1(0.9)
	Trichoptera	Hydropsychidae	Caddisfly	2(11.3)	1(1.8)	1(1.8)	1(1.6)	2(3.4)
		Philopotamidae	Caddisfly	1(8)	0(0)	1(1.8)	0(0)	0(0)
		Rhyacophilidae	Caddisfly	0(0)	1(.9)	1(0.9)	1(4.0)	1(0.9)
Nemertea	Hoploneustea	Tetrastemmatidae	Worm	0(0)	0(0)	0(0)	1(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Double Lick Run (SAVA-276-S)

Site SAVA-276-S is located on Double Lick Run in the Highlands region of Maryland. It is in the Savage River Watershed in Garrett County. This site was sampled in 1996 and 2000 to 2004. Its watershed is primarily forested (93%), with 7% agriculture.



Double Lick Run in the spring 2004.

Water Chemistry

Summer water chemistry data collected at Double Lick Run (1996 and 2000 to 2004).

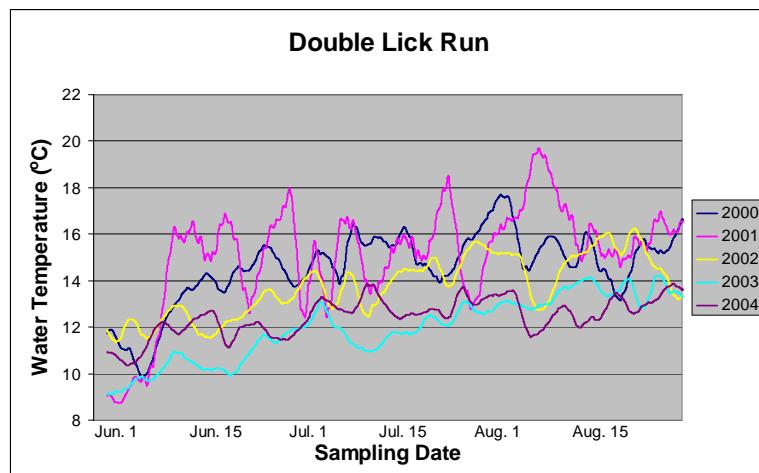
Parameter	1996	2000	2001	2002	2003	2004
Field pH	6.8	6.8	6.8	6.3	6.7	6.8
Dissolved Oxygen (mg/L)	9	8.3	10.1	11.8	10	8.1
Conductivity (mS)	0.06	0.05	0.05	0.05	0.05	0.05
Turbidity (NTU)	Not measured	2.6	0.7	1.5	1.1	2.6

Physical Habitat

Physical habitat measurements collected at Double Lick Run (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	13	16	16	14	17	12
Epifaunal substrate (0-20)	12	18	19	18	19	15
Velocity/Depth Diversity (0-20)	9	10	13	10	15	10
Pool Quality (0-20)	7	10	15	10	16	10
Riffle Quality (0-20)	11	9	15	10	17	13
Shading (%)	90	98	93	95	98	96
Embeddedness (%)	40	10	15	20	15	30
Discharge (cfs)	.33	.36	.20	.07	.64	1.12

The graph below displays the temperature logger data for Double Lick Run for 2000 to 2004.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Double Lick Run by sampling year.

Parameter	1996	2000	2001	2002	2003	2004
Blue ridge sculpin	39	16	19	16	19	19
Brook trout	4	32	59	44	67	152

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Double Lick Run.

Order (Common)	Species
Caudata (Salamanders and Newts)	Allegheny Mountain Dusky Salamander, Northern Dusky Salamander, Northern Slimy Salamander, Northern Spring Salamander, Northern Two-lined Salamander, Red-Spotted Newt, Seal Salamander

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Double Lick Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	*(0.8)	*(0.9)	*(0.8)	*(1.7)
Arthropoda	Amphipoda	Gammaridae	Scud	1(10.0)	1(5.2)	1(10.1)	1(27.5)	1(16.7)	1(21.5)
	Coleoptera	Elmidae	Beetle	1(1.0)	*(0.9)	0(0)	0(0)	0(0)	1(0.8)
	Diptera	Ceratopogonidae	True Fly	0(0)	0(0)	1(0.8)	0(0)	0(0)	0(0)
		Chironomidae	True Fly	2(2.0)	6(12.2)	3(5.9)	5(9.2)	3(7.9)	4(5.0)
		Empididae	True Fly	0(0)	1(0.9)	0(0)	0(0)	0(0)	0(0)
		Simuliidae	True Fly	1(1.0)	1(0.9)	1(0.8)	1(1.8)	0(0)	0(0)
		Tipulidae	True Fly	0(0)	1(0.9)	0(0)	2(3.7)	2(2.4)	1(0.8)
	Ephemeroptera	Ameletidae	Mayfly	0(0)	0(0)	1(2.5)	1(1.8)	1(0.8)	0(0)
		Baetidae	Mayfly	0(0)	*(0.9)	0(0)	1(0.9)	0(0)	1(2.5)
		Ephemerellidae	Mayfly	1(13)	2(6.1)	1(19.3)	1(1.8)	1(24.6)	2(35.5)
		Heptageniidae	Mayfly	2(31)	3(31.3)	1(39.5)	3(28.4)	1(17.5)	1(4.1)
		Leptophlebiidae	Mayfly	1(5)	1(8.7)	1(3.4)	0(4.6)*	1(1.6)	0(0)
	Plecoptera	Chloroperlidae	Stonefly	*(4)	1(2.6)	0(0)	2(5.5)	*(2.4)	1(4.1)
		Leuctridae	Stonefly	1(6)	1(14.8)	*(4.2)	2(3.7)	1(9.5)	1(9.9)
		Nemouridae	Stonefly	2(16)	1(7.8)	1(6.7)	2(1.8)	1(5.6)	1(1.7)
		Peltoperlidae	Stonefly	1(2)	1(0.9)	0(0)	0(0)	0(0)	0(0)
		Perlidae	Stonefly	*(2)	*(1.7)	*(1.7)	*(0.9)	*(3.2)	1(7.4)
		Pteronarcyiidae	Stonefly	1(2)	1(1.7)	1(1.7)	1(0.9)	0(0)	1(0.8)
	Trichoptera	Hydropsychidae	Caddisfly	2(3)	1(0.9)	*(0.8)	1(0.9)	1(1.6)	1(0.8)
		Limnephilidae	Caddisfly	0(0)	1(0.9)	0(0)	0(0)	0(0)	0(0)
		Philopotamidae	Caddisfly	1(1)	0(0)	0(0)	2(1.8)	*(0.8)	1(0.8)
		Rhyacophilidae	Caddisfly	0(0)	1(0.9)	1(0.8)	1(0.9)	1(2.4)	1(2.5)
		Uenoidae	Caddisfly	1(1)	0(0)	1(0.8)	1(1.8)	1(2.4)	0(0)
Nematomorpha	Gordioidea	Gordiidae	Worm	0(0)	0(0)	0(0)	*(0.9)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Fifteenmile Creek (FIMI-207-S)

Site FIMI-207-S is located on Fifteenmile Creek in the Highlands region of Maryland. It is in the Fifteen Mile Creek Watershed in Allegany County. This site was sampled in 1995 and 2000 to 2004. Its watershed is primarily forested (90%), with 6% barren and 4% agriculture.



Fifteenmile Creek in spring 2004.

Water Chemistry

Summer water chemistry data collected at Fifteenmile Creek (1995 and 2000 to 2004).

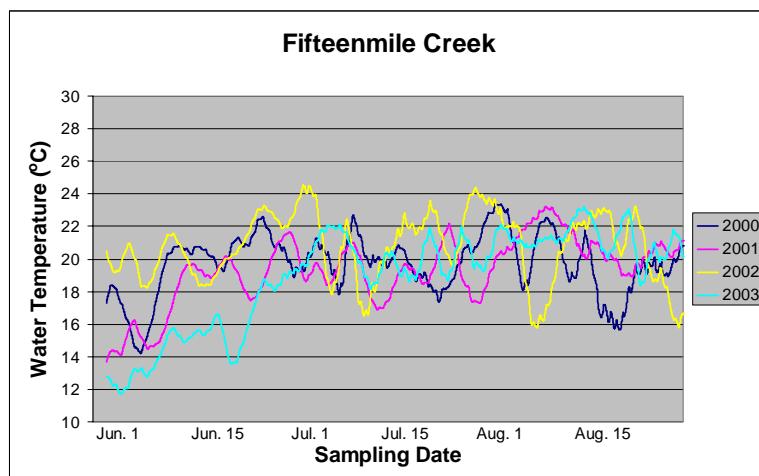
Parameter	1995	2000	2001	2002	2003	2004
Field pH	7.3	7.6	7.2	7.3	7.3	6.2
Dissolved Oxygen (mg/L)	7.4	9	7.4	8.6	7.2	8.4
Conductivity (mS)	0.06	0.07	0.08	0.08	0.07	0.06
Turbidity (NTU)	Not measured	0.5	0.7	0.2	0.2	2.6

Physical Habitat

Physical habitat measurements collected at Fifteenmile Creek (1995 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1995	2000	2001	2002	2003	2004
Instream habitat (0-20)	13	15	11	11	11	13
Epifaunal substrate (0-20)	8	10	11	11	10	16
Velocity/Depth Diversity (0-20)	8	9	5	5	8	10
Pool Quality (0-20)	18	8	6	10	9	10
Riffle Quality (0-20)	0	11	5	11	8	15
Shading (%)	30	50	50	65	60	60
Embeddedness (%)	0	5	10	15	20	20
Discharge (cfs)	2.23	.55	.10	.09	.22	3.05

The graph below displays the temperature logger data for Fifteenmile Creek for 2000 to 2003. Maximum recorded temperatures occurred during the drought in July and August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in Fifteenmile Creek by sampling year.

Parameter	1995	2000	2001	2002	2003	2004
Blue ridge sculpin	0	0	0	1	0	0
Bluntnose minnow	9	23	5	28	26	43
Central stoneroller	0	208	125	300	79	182
Chain pickerel	19	0	2	0	0	0
Creek chub	0	28	85	43	5	24
Creek chubsucker	18	0	0	0	2	0
Eastern blacknose dace	0	215	211	83	34	17
Fallfish	1	0	0	0	3	0
Fantail darter	0	56	164	92	68	106
Green sunfish	11	1	0	0	3	0
Greenside darter	0	48	32	17	5	25
Largemouth bass	2	0	0	0	0	0
Longnose dace	0	29	35	10	2	15
Northern hog sucker	0	0	4	0	0	2
Potomac sculpin	10	165	217	239	122	345
Redbreast sunfish	0	0	0	0	1	0
Rock bass	16	0	3	6	0	7
Smallmouth bass	5	8	0	2	0	4
White sucker	3	9	22	10	3	5

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Fifteenmile Creek.

Order (Common)	Species
Anura (Frogs and Toads)	Northern Green Frog, Pickerel Frog
Caudata (Salamanders and Newts)	Red-Spotted Newt, Northern Two-Lined Salamander
Squamata (Snakes and Lizards)	Northern Watersnake

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Fifteenmile Creek by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1995 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaxida	Naididae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)
	Lumbriculida	Lumbriculidae	Worm	*(4.4)	0(0)	0(0)	0(0)	0(0)	0(0)
Arthropoda	Coleoptera	Elmidae	Beetle	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)
		Psephenidae	Beetle	0(0)	0(0)	0(0)	1(2.9)	0(0)	0(0)
	Decapoda	Camaridae	Crayfish	*(1.1)	0(0)	0(0)	0(0)	0(0)	0(0)
	Diptera	Athericidae	True Fly	0(0)	0(0)	0(0)	1(3.9)	0(0)	0(0)
		Chironomidae	True Fly	5(22.0)	2(4.2)	4(9.1)	6(13.7)	3(17.6)	4(6.8)
		Simuliidae	True Fly	1(1.1)	2(22.9)	1(20)	1(7.8)	1(8.8)	0(0)
		Tipulidae	True Fly	1(1.1)	0(0)	0(0)	0(0)	0(0)	1(1.7)
	Ephemeroptera	Ameletidae	Mayfly	1(1.1)	0(0)	0(0)	0(0)	1(1.6)	0(0)
		Baetidae	Mayfly	0(0)	1(2.5)	0(0)	0(0)	0(0)	*(0.9)
		Caenidae	Mayfly	1(2.2)	0(0)	0(0)	0(0)	1(0.8)	0(0)
		Ephemerellidae	Mayfly	2(5.50)	2(10.2)	2(17.3)	1(2.0)	3(26.4)	3(19.5)
		Ephemeridae	Mayfly	1(2.2)	0(0)	0(0)	0(0)	0(0)	0(0)
		Heptageniidae	Mayfly	3(44.0)	2(4.2)	1(10.9)	2(10.8)	2(8)	3(51.7)
		Isonychiidae	Mayfly	0(0)	0(0)	1(0.9)	1(3.9)	0(0)	0(0)
		Leptophlebiidae	Mayfly	0(0)	*(7.6)	0(0)	0(0)	1(3.2)	0(0)
	Isopoda	Asellidae	Aquatic	1(1.1)	0(0)	1(0.9)	0(0)	0(0)	1(1.7)
			Sow Bug						
	Megaloptera	Corydalidae	Alderfly/Fishfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)
	Odonata	Gomphidae	Dragonfly/Damselfly	0(0)	0(0)	0(0)	1(7.8)	0(0)	0(0)
	Plecoptera	Capniidae	Stonefly	0(0)	0(0)	0(0)	*(2.0)	0(0)	0(0)
		Chloroperlidae	Stonefly	1(7.7)	*(5.9)	*(0.9)	0(0)	0(0)	1(5.9)
		Leuctridae	Stonefly	0(0)	0(0)	*(0.9)	0(0)	*(0.8)	*(2.5)
		Nemouridae	Stonefly	1(3.3)	1(32.2)	1(20.9)	1(9.8)	3(22.4)	1(4.2)

<i>PHYLUM</i>	<i>ORDER</i>	<i>FAMILY</i>	<i>COMMON NAME</i>	<i>1995 genera (RA)</i>	<i>2000 genera (RA)</i>	<i>2001 genera (RA)</i>	<i>2002 genera (RA)</i>	<i>2003 genera (RA)</i>	<i>2004 genera (RA)</i>
Trichoptera	Trichoptera	Perlidae	Stonefly	0(0)	0(0)	1(0.9)	*(2.0)	0(0)	0(0)
		Perlodidae	Stonefly	*(1.1)	1(2.5)	*(4.6)	0(0)	1(4.8)	1(4.2)
		Taeniopterygidae	Stonefly	0(0)	0(0)	1(8.2)	1(4.9)	1(0.8)	0(0)
		Hydropsychidae	Caddisfly	1(1.1)	1(0.9)	1(2.7)	1(20.6)	0(0)	0(0)
		Philopotamidae	Caddisfly	0(0)	*(5.9)	*(1.8)	1(1.0)	*(3.2)	0(0)
		Polycentropodidae	Caddisfly	1(1.1)	0(0)	0(0)	0(0)	0(0)	0(0)
		Uenoidae	Caddisfly	0(0)	0(0)	0(0)	1(3.9)	1(0.8)	1(0.9)
Platyhelminthes	Tricladida	Planariidae	Flatworm	0(0)	1(0.9)	0(0)	*(1.0)	0(0)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

High Run (UMON-288-S)

Site UMON-288-S is located on High Run in the Highlands region of Maryland. It is in the Upper Monocacy River Watershed in Frederick County. This site was sampled in 1996 and 2000 to 2004. Its watershed is primarily forested (82%), with 12% agriculture and 7% urban.



High Run in spring 2004.

Water Chemistry

Summer water chemistry data collected at High Run (1996 and 2000 to 2004)

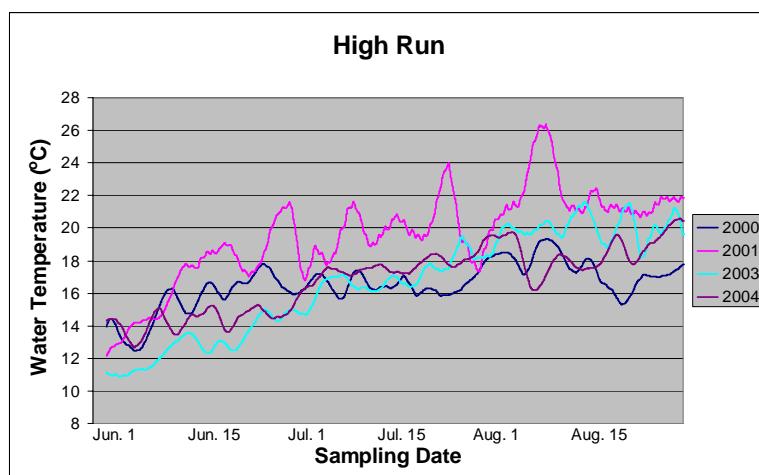
Parameter	1996	2000	2001	2002	2003	2004
Field pH	8.2	7.1	6.7	6.1	6.5	6.6
Dissolved Oxygen (mg/L)	8.7	7.9	8.9	10.5	8.3	7.3
Conductivity (mS)	0.08	0.02	0.02	0.02	0.02	0.02
Turbidity (NTU)	Not measured	2.5	2.2	2.2	0.7	2.1

Physical Habitat

Physical habitat measurements collected at High Run (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	12	17	18	18	17	17
Epifaunal substrate (0-20)	4	18	16	18	16	19
Velocity/Depth Diversity (0-20)	14	14	10	10	11	16
Pool Quality (0-20)	16	17	15	13	14	16
Riffle Quality (0-20)	14	17	15	17	16	17
Shading (%)	97	95	85	92	95	95
Embeddedness (%)	55	20	20	20	35	20
Discharge (cfs)	3.32	1.11	.28	.46	.84	1.48

The above graph displays the temperature logger data for High Run for 2000 to 2001 and 2003 to 2004. Maximum recorded temperatures occurred during August 2001.



Biology

Fish

Cumulative list of fish species (with abundance) collected in High Run by sampling year.

Parameter	1996	2000	2001	2002	2003	2004
Blue ridge sculpin	57	0	0	0	0	0
Brook trout	0	41	167	30	23	67
Creek chub	28	0	0	0	0	0
Eastern blacknose dace	104	0	0	0	0	0
Fallfish	10	0	0	0	0	0
Fantail darter	5	0	0	0	0	0
Greenside darter	2	0	0	0	0	0
Longnose dace	1	0	0	0	0	0
Potomac sculpin	112	0	0	0	0	0
Rosy side dace	79	0	0	0	0	0
White sucker	23	0	0	0	0	0

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near High Run.

Order(Common)	Species
Anura (Frogs and Toads)	Eastern American Toad, Northern Green Frog, Pickerel Frog
Caudata (Salamanders and Newts)	Northern Dusky Salamander, Northern Two-Lined Salamander

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in High Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Brachiobdellida			0(0)	*(1.6)	0(0)	0(0)	0(0)	0(0)
	Haplotauxida	Naididae	Worm	0(0)	*(0.8)	0(0)	0(0)	0(0)	0(0)
Arthropoda	Coleoptera	Elmidae	Beetle	1(10.3)	1(7.4)	1(2.8)	2(25.7)	2(7.6)	0(0)
		Psephenidae	Beetle	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
	Decapoda	Cambaridae	Crayfish	0(0)	1(0.8)	0(0)	0(0)	0(0)	0(0)
	Diptera	Chironomidae	True Fly	4(20.6)	4(3.3)	1(6.5)	3(8.6)	6(13.6)	3(7.9)
		Simuliidae	True Fly	2(25.8)	1(0.8)	1(3.7)	0(0)	1(2.5)	0(0)
		Tipulidae	True Fly	2(2.1)	0(0)	0(0)	3(3.4)	2(1.7)	2(4.8)
	Ephemeroptera	Baetidae	Mayfly	0(0)	2(7.4)	*(4.6)	*(1.7)	0(0)	1(13.5)
		Ephemerellidae	Mayfly	1(1.0)	1(36.9)	1(41.7)	1(22.2)	1(20.3)	1(17.5)
		Heptageniidae	Mayfly	3(16.5)	3(9.8)	1(20.4)	1(13.7)	1(11.9)	2(15.9)
		Isonychiidae	Mayfly	1(2.1)	0(0)	0(0)	0(0)	0(0)	0(0)
		Leptophlebiidae	Mayfly	0(0)	1(11.5)	*(4.6)	1(9.4)	1(11.0)	1(7.1)
	Plecoptera	Capniidae	Stonefly	*(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
		Chloroperlidae	Stonefly	0(0)	1(1.6)	0(0)	0(0)	1(0.9)	1(4.0)
		Leuctridae	Stonefly	0(0)	1(2.5)	1(3.7)	1(1.7)	1(2.5)	1(4.8)
		Nemouridae	Stonefly	1(4.1)	1(2.5)	0(0)	0(0)	0(0)	0(0)
		Peltoperlidae	Stonefly	0(0)	0(0)	0(0)	0(0)	1(2.5)	0(0)
		Perlidae	Stonefly	0(0)	0(0)	1(0.9)	0(0)	*(0.9)	*(0.8)
		Perlodidae	Stonefly	0(0)	*(4.1)	*(1.9)	*(4.3)	*(4.2)	*(2.4)
		Pteronarcyiidae	Stonefly	0(0)	0(0)	0(0)	1(0.9)	0(0)	0(0)
Trichoptera		Hydropsychidae	Caddisfly	3(10.3)	1(6.6)	2(5.6)	1(5.1)	1(13.6)	2(18.3)
		Lepidostomatidae	Caddisfly	0(0)	1(2.5)	1(0.9)	1(3.4)	1(0.9)	0(0)
		Philopotamidae	Caddisfly	1(1.0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
		Polycentropodidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.9)	0(0)
		Rhyacophilidae	Caddisfly	1(1.0)	0(0)	1(0.9)	0(0)	1(0.9)	1(3.2)
		Uenoidae	Caddisfly	1(4.1)	0(0)	1(0.9)	0(0)	1(0.9)	0(0)
Nematomorpha	Gordioidea	Gordiidae	Worm	0(0)	0(0)	*(0.9)	0(0)	*(1.7)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Mill Run (PRLN-626-S)

Site PRLN-626-S is located on Mill Run in the Highlands region of Maryland. It is in the Lower North Branch Potomac River Watershed in Allegany County. This site was sampled in 1996 and 2000 to 2004. Its watershed is 100% forested.



Mill Run in spring 2004.

Water Chemistry

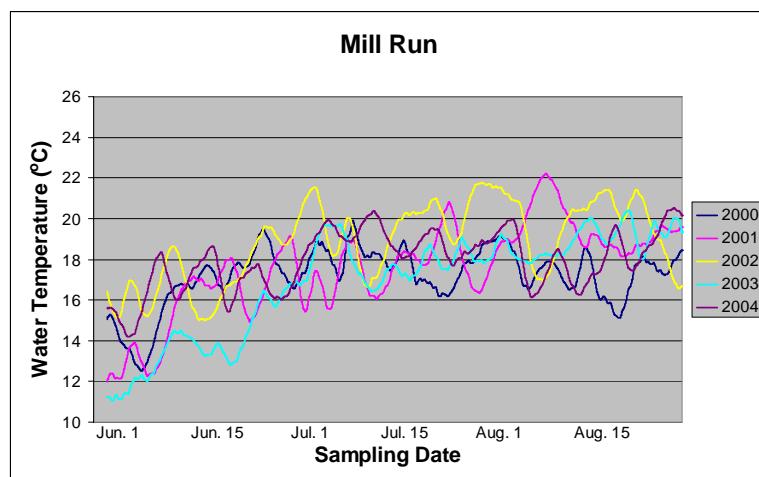
Summer water chemistry data collected at Mill Run (1996 and 2000 to 2004).

Parameter	1996	2000	2001	2002	2003	2004
Field pH	7.7	7.4	7.7	7.9	7.5	7.7
Dissolved Oxygen (mg/L)	8.5	6.8	8.9	8.8	8.4	8.3
Conductivity (mS)	0.14	0.11	0.16	0.19	0.12	0.16
Turbidity (NTU)	Not measured	6.2	4.3	13.2	7.6	4.3

Physical Habitat

Physical habitat measurements collected at Mill Run (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	15	17	18	16	18	16
Epifaunal substrate (0-20)	10	17	18	16	14	16
Velocity/Depth Diversity (0-20)	14	16	10	10	10	10
Pool Quality (0-20)	15	16	15	10	12	14
Riffle Quality (0-20)	12	17	16	14	16	15
Shading (%)	95	90	85	94	95	90
Embeddedness (%)	0	0	15	20	35	35
Discharge (cfs)	.51	1.47	.29	.26	.73	.50



The above graph displays the temperature logger data for Mill Run for 2000 to 2004.

Biology

Fish

Cumulative list of fish species (with abundance) collected in Mill Run by sampling year.

Parameter	1996	2000	2001	2002	2003	2004
Blue ridge sculpin	0	54	137	120	40	40
Brook trout	5	28	36	16	61	96
Eastern blacknose dace	0	100	124	134	108	79

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near Mill Run.

Order (Common)	Species
Anura (Frogs and Toads)	Northern Green Frog
Caudata (Salamanders and Newts)	Northern Dusky Salamander, Northern Slimy Salamander, Northern Two-Lined Salamander

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in Mill Run by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)
Annelida	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)
	Lumbriculida	Lumbriculidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)
Arthropoda	Coleoptera	Elmidae	Beetle	0(0)	2(1.7)	0(0)	1(1.9)	1(0.8)	0(0)
	Psephenidae	Beetle	0(0)	1(0.9)	0(0)	0(0)	0(0)	0(0)	0(0)
Decapoda	Cambaridae	Crayfish	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)	0(0)
	Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	0(0)	0(0)	*(0.8)	1(0.9)
Diptera	Chironomidae	True Fly	2(10.8)	3(11.9)	4(11.0)	7(30.5)	4(8.4)	3(5.1)	
	Empididae	True Fly	0(0)	0(0)	1(3.4)	0(0)	0(0)	0(0)	0(0)
Ephemeroptera	Simuliidae	True Fly	2(2.5)	2(4.2)	1(31.4)	1(3.8)	1(13.5)	1(11.9)	
	Tipulidae	True Fly	1(0.8)	2(1.7)	0(0)	1(1.0)	0(0)	0(0)	0(0)
Megaloptera	Ameletidae	Mayfly	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)	
	Baetidae	Mayfly	1(5)	1(15.3)	*(5.9)	1(11.4)	2(5.9)	1(12.7)	
Odonata	Ephemerellidae	Mayfly	1(4.2)	1(2.5)	1(4.2)	1(2.9)	2(5.9)	1(1.7)	
	Heptageniidae	Mayfly	2(21.7)	3(17.8)	1(11.0)	2(6.7)	3(19.3)	1(32.2)	
Plecoptera	Isonychiidae	Mayfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)	
	Leptophlebiidae	Mayfly	1(5)	1(13.6)	1(8.5)	1(20)	1(10.1)	1(6.8)	
Trichoptera	Sialidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)	
	Gomphidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)	
Capniidae	Stonefly	0(0)	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)	
	Chloroperlidae	Stonefly	1(0.8)	0(0)	0(0)	1(1.0)	0(0)	0(0)	
Leuctridae	Stonefly	0(0)	*(0.9)	*(0.9)	0(0)	0(0)	0(0)	*(1.7)	
	Nemouridae	Stonefly	1(2.5)	*(1.7)	1(3.4)	0(0)	1(1.7)	1(3.4)	
Peltoperlidae	Stonefly	1(29.2)	1(11.0)	1(5.9)	1(6.7)	1(11.8)	0(0)		
	Perlidae	Stonefly	1(1.7)	0(0)	1(0.9)	0(0)	0(0)	0(0)	
Perlodidae	Stonefly	0(0)	*(0.9)	1(2.5)	*(1.9)	*(0.8)	*(0.8)	*(1.7)	
	Pteronarcyidae	Stonefly	1(6.7)	1(5.1)	1(3.4)	1(1.9)	1(1.7)	1(5.9)	
Hydropsychidae	Stonefly	1(2.5)	1(4.2)	1(0.9)	1(1.0)	1(2.5)	1(2.5)	1(1.7)	
	Limnephilidae	Caddisfly	1(6.7)	1(5.9)	1(3.4)	3(3.8)	2(10.1)	2(9.3)	
Philopotamidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)	
	Polycentropodidae	Caddisfly	0(0)	1(0.9)	0(0)	0(0)	0(0)	0(0)	
Rhyacophilidae	Caddisfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)	1(1.7)	
	Uenoidae	Caddisfly	0(0)	0(0)	1(1.7)	1(1.9)	1(1.7)	1(3.4)	

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

Savage River (SAVA-225-S)

Site SAVA-225-S is located on the Savage River in the Highlands region of Maryland. It is in the Savage River Watershed in Garrett County. This site was sampled in 1996 and 2000 to 2004. Its watershed is primarily forested (84%), with 15% agriculture.



Savage River in spring 2004.

Water Chemistry

Summer water chemistry data collected at the Savage River (1996 and 2000 to 2004).

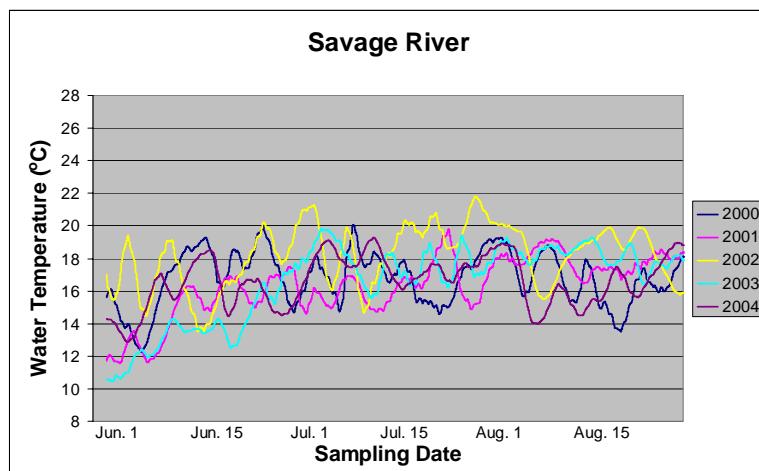
Parameter	1996	2000	2001	2002	2003	2004
Field pH	6.8	7.6	7.5	7.0	7.1	6.7
Dissolved Oxygen (mg/L)	7.8	8.9	7.9	10.6	8.9	8.3
Conductivity (mS)	0.09	0.14	0.21	0.18	0.17	0.22
Turbidity (NTU)	Not measured	0.9	2.2	2.6	2.8	2

Physical Habitat

Physical habitat measurements collected at the Savage River (1996 and 2000 to 2004). Scored parameters are on a 0 (worst) to 20 (best) scale.

Parameter	1996	2000	2001	2002	2003	2004
Instream habitat (0-20)	16	19	18	19	19	17
Epifaunal substrate (0-20)	16	18	16	17	19	17
Velocity/Depth Diversity (0-20)	13	18	16	16	17	15
Pool Quality (0-20)	15	19	17	17	18	18
Riffle Quality (0-20)	16	18	18	20	18	17
Shading (%)	40	75	75	65	90	85
Embeddedness (%)	25	15	10	20	25	30
Discharge (cfs)	6.81	4.91	4.84	3.45	4.60	4.95

The graph below displays the temperature logger data for the Savage River for 2000 to 2004. Maximum recorded temperatures occurred during the drought in July and August 2002.



Biology

Fish

Cumulative list of fish species (with abundance) collected in the Savage River by sampling year.

Parameter	1996	2000	2001	2002	2003	2004
Blue ridge sculpin	140	161	213	225	213	127
Brook trout	1	10	30	42	24	33
Brown trout	0	3	0	0	1	1
Central stoneroller	51	0	0	0	0	0
Common shiner	4	0	1	0	0	1
Creek chub	1	2	4	11	3	1
Cutlip minnow	28	24	33	58	61	55
Eastern blacknose dace	165	89	88	134	99	130
Fantail darter	62	34	56	27	41	24
Longnose dace	209	107	82	90	142	128
Margined madtom	9	0	0	0	0	0
Northern hog sucker	1	0	0	0	0	0
Potomac sculpin	10	23	30	23	28	24
Rainbow trout	1	0	0	1	1	0
River chub	25	0	0	0	0	0
Rock bass	15	0	0	0	0	0
Rosyside dace	1	3	12	18	3	6
Smallmouth bass	1	0	0	0	0	0
White sucker	34	7	18	11	19	10
Yellow perch	0	0	2	0	0	0

Red indicates tolerant fish; blue are moderately tolerant; and green are intolerant.

Herpetofauna

Cumulative list of herpetofauna species collected in or near the Savage River.

Order (Common)	Species
Caudata (Salamanders and Newts)	Allegheny Mountain Dusky Salamander, Northern Dusky Salamander, Northern Spring Salamander, Northern Two-lined Salamander,
Squamata (Snakes and Lizards)	Eastern Rat Snake, Northern Watersnake

Benthic Macroinvertebrates

Cumulative list of benthic macroinvertebrates collected in the Savage River by sampling year, (genera (RA)) = (number of genera (percent relative abundance)).

PHYLUM	ORDER	FAMILY	COMMON NAME	1996 genera (RA)	2000 genera (RA)	2001 genera (RA)	2002 genera (RA)	2003 genera (RA)	2004 genera (RA)	
Arthropoda	Haplotaxida	Enchytraeidae	Worm	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)	
	Lumbriculida	Lumbriculidae	Worm	0(0)	*(1.0)	*(0.8)	0(0)	0(0)	0(0)	
	Coleoptera	Elmidae	Beetle	0(0)	1(1.0)	0(0)	1(1.0)	0(0)	0(0)	
	Diptera	Psephenidae	Beetle	0(0)	0(0)	0(0)	0(0)	0(0)	1(1)	
Ephemeroptera	Blephariceridae	True Fly	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(1)	
	Ceratopogonidae	True Fly	0(0)	0(0)	0(0)	0(0)	0(0)	*(0.8)	0(0)	
	Chironomidae	True Fly	4(12.4)	7(14.7)	7(23.1)	3(14.6)	10(19.3)	6(15.0)		
	Simuliidae	True Fly	1(1.0)	1(1.0)	1(23.1)	0(0)	1(3.4)	1(4)		
	Tipulidae	True Fly	1(1.0)	2(2.0)	0(0)	0(0)	2(1.7)	0(0)		
	Ameletidae	Mayfly	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)		
	Baetidae	Mayfly	1(1.0)	2(3.9)	1(4.1)	*(5.8)	2(4.2)	1(6)		
	Ephemerellidae	Mayfly	1(27.8)	3(35.3)	1(31.4)	3(31.1)	3(31.1)	2(24.0)		
	Ephemeridae	Mayfly	1(1.03)	0(0)	0(0)	1(1.0)	0(0)	0(0)		
	Heptageniidae	Mayfly	2(15.5)	3(11.8)	1(7.4)	1(2.9)	1(3.4)	2(9.0)		
Megaloptera	Isonychiidae	Mayfly	1(6.2)	1(3.9)	0(0)	1(3.9)	1(0.8)	1(2)		
	Leptophlebiidae	Mayfly	1(12.4)	1(9.8)	1(3.3)	1(18.5)	1(19.3)	1(10.0)		
	Corydalidae	Alderfly/ Fishfly	0(0)	0(0)	0(0)	0(0)	0(0)	1(1)		
	Odonata	Aeshnidae	Dragonfly/ Damselfly	0(0)	0(0)	0(0)	1(1.0)	0(0)	0(0)	
	Plecoptera	Capniidae	Stonefly	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)	
	Chloroperlidae	Stonefly	0(0)	1(2.0)	0(0)	0(0)	1(0.8)	*(1.0)		
	Leuctridae	Stonefly	0(0)	0(0)	1(1.7)	1(1.0)	0(0.8)*	1(8.0)		
	Nemouridae	Stonefly	*(1.0)	1(2.9)	0(0)	0(0)	1(1.7)	1(1.0)		
	Perlidae	Stonefly	1(5.2)	1(2.9)	0(0)	0(0)	0(0)	1(4.0)		

	Perlodidae	Stonefly	1(5.2)	1(3.9)	1(1.7)	*(2.9)	1(4.2)	1(6.0)
Trichoptera	Brachycentridae	Caddisfly	1(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)
	Hydropsychidae	Caddisfly	1(6.2)	1(2.0)	2(1.7)	2(4.9)	1(0.8)	3(7.0)
	Lepidostomatidae	Caddisfly	1(2.1)	0(0)	1(1.7)	1(11.7)	1(2.5)	0(0)
	Limnephilidae	Caddisfly	0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)
	Rhyacophilidae	Caddisfly	0(0)	1(1.0)	0(0)	0(0)	1(1.7)	0(0)
	Uenoidae	Caddisfly	0(0)	1(1.0)	0(0)	0(0)	0(0)	0(0)
Mollusca	Gastropoda		0(0)	0(0)	0(0)	0(0)	1(0.8)	0(0)

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 4 to 6); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

